THE JOURNAL OF GAS LIGHTING
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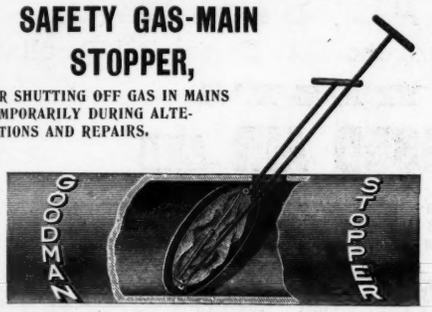

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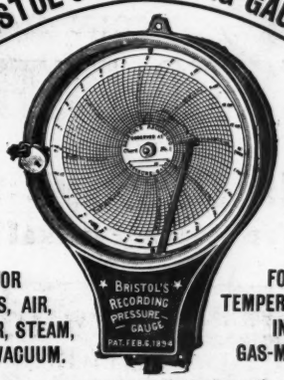

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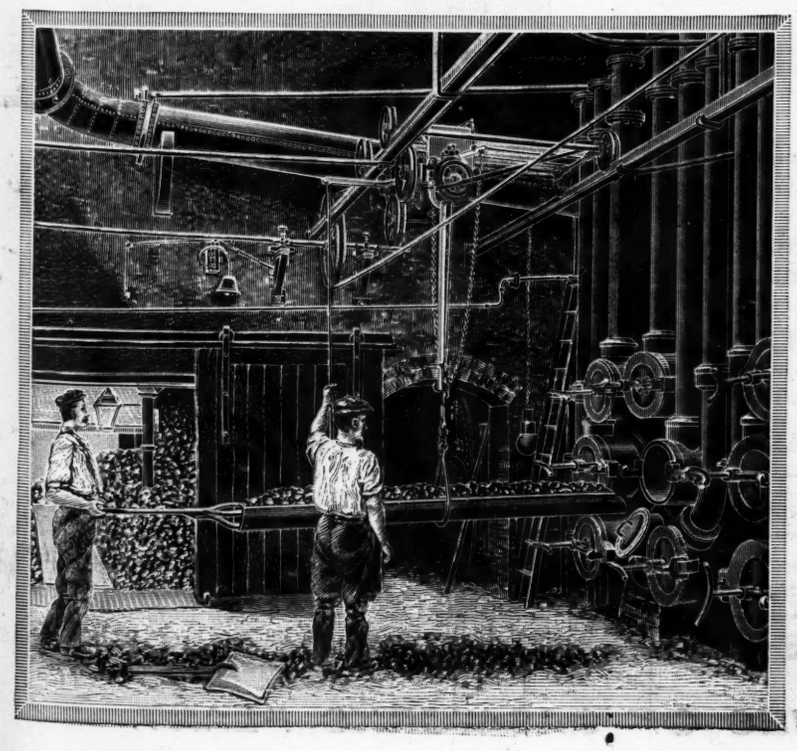

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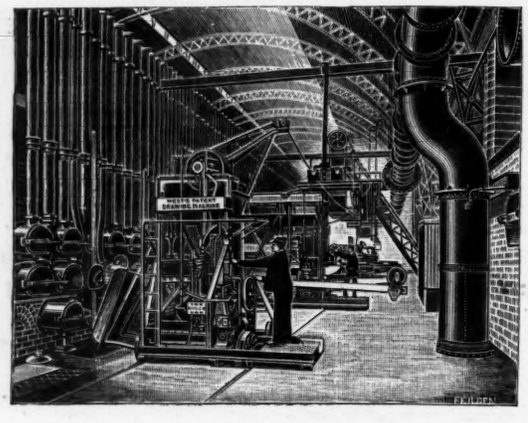

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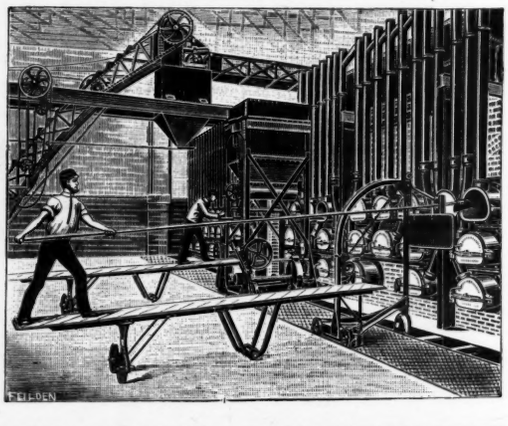

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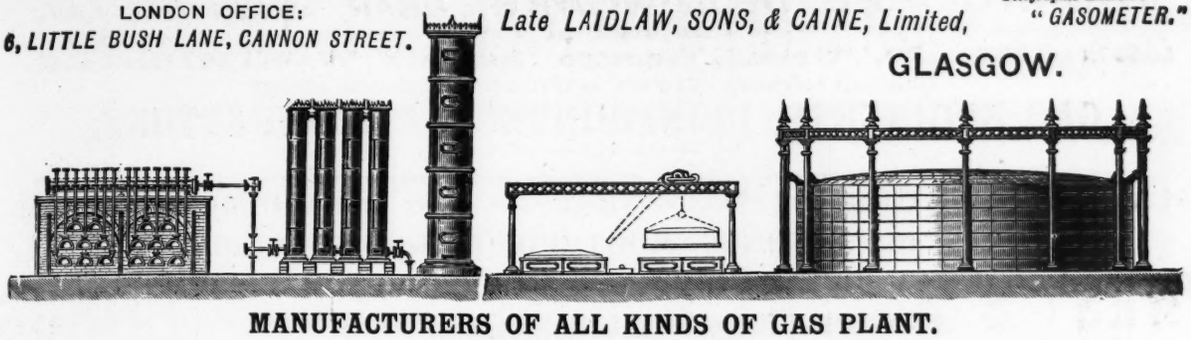

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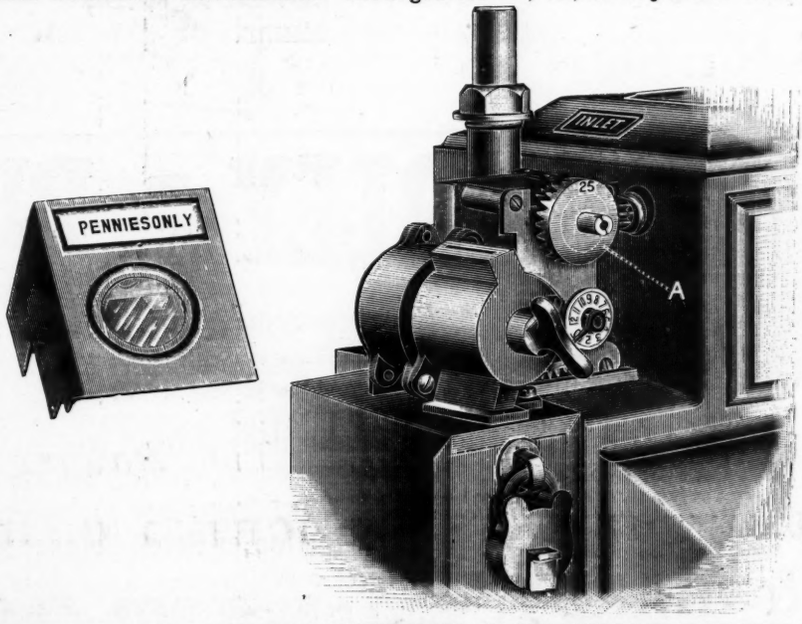

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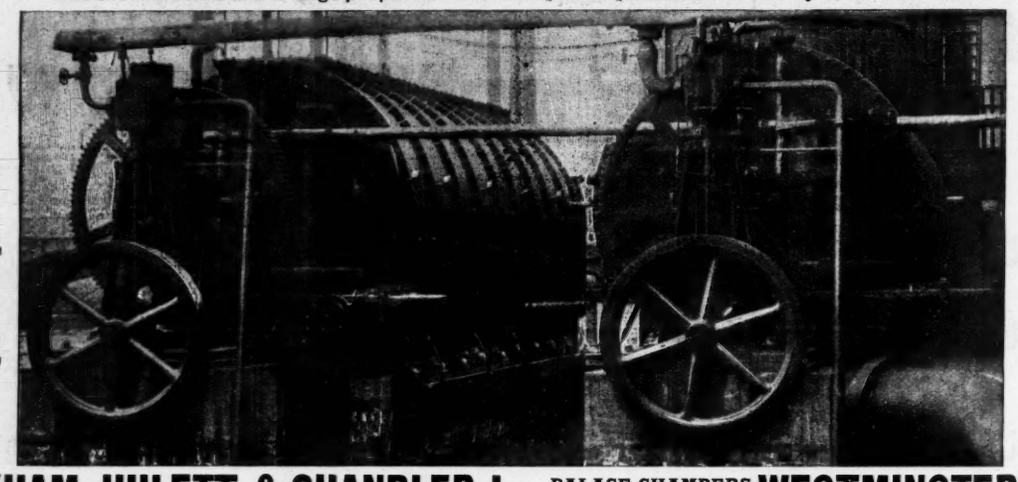

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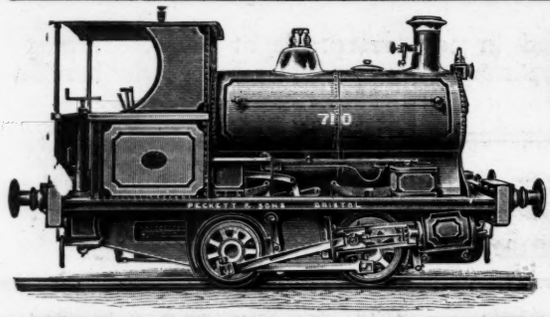

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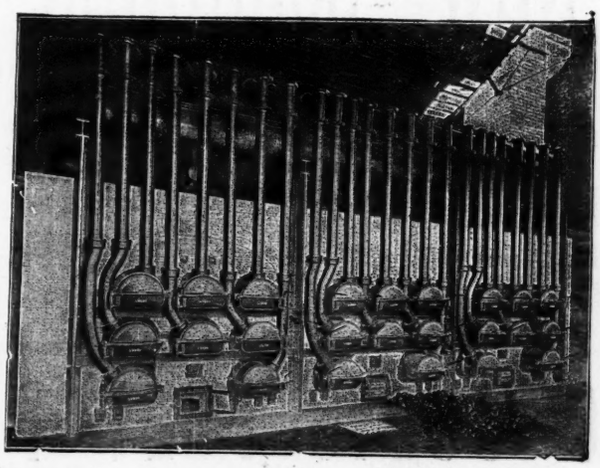

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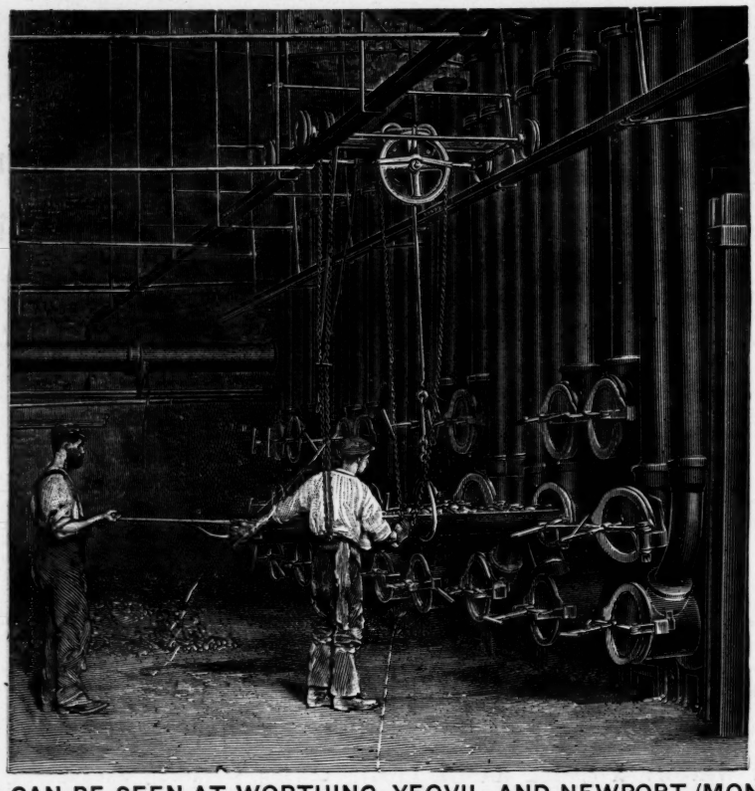

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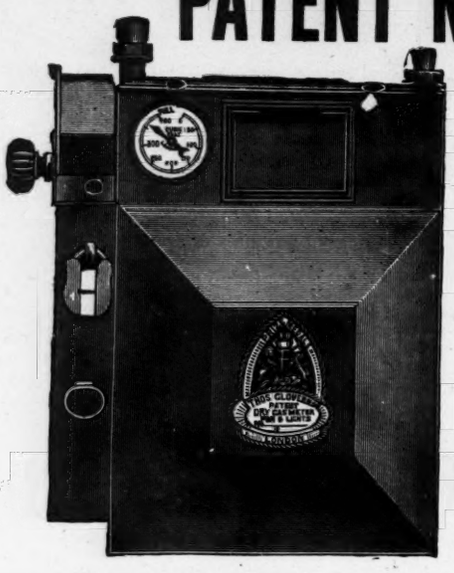

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JOURNAL OF GAS LIGHTING, WATER SUPPLY, &c.

VOL. LXXVIII., No. 2000.—TUESDAY, SEPTEMBER 10, 1901.

EDITORIAL NOTES.

Our Two-Thousandth Appearance.

RATHER more than nineteen years ago—to be exact, on July 11, 1882—the thousandth number of the "JOURNAL" was published; and the present is the two thousandth number of our publication. The occasion is naturally interesting for those whose work it is to prepare and bring out these periodical issues of a scientific, technical, and trade journal of such long standing; and there are reasons why readers may also take note of the record, which is unparalleled in the chronicles of specialized journalism. Although the gas industry is far from being an ancient craft or mystery—as compared with most of the callings whose names are given to the Guilds of London, it is an upstart of a single century old—it is a curious fact that the periodical founded to represent the literary side of the industry is now the oldest of its class in existence. And when attention is drawn to the mass of reading which this present number contains, it will hardly appear an excessive claim to state that the "JOURNAL" is still, as always, up to its time. Nineteen years ago we celebrated our "milliary" by passing in review the character and contents of the first number. This need not be repeated; but instead we will refer briefly to the differences between the gas industry of 1882 and of to-day, as reflected in the columns of the "JOURNAL."

While the present issue is full of the proceedings of the Civil and Gas Engineering Congresses of Edinburgh and Glasgow, our thousandth number contained a report of part of the transactions of the nineteenth annual meeting of the Incorporated Gas Institute. This consisted of a paper by Mr. John Chew, the veteran Gas Engineer of Blackpool, entitled "Some Remarks on Electricity and Petroleum as Competitors of Coal Gas," which, with the discussion that followed, exhibits very strikingly the change that has since come over all these industries. Blackpool had then already some practical experience of public electric lighting, having installed nine arc lamps upon its Esplanade, carried on posts 60 feet high, and making what was then an unequalled display. It is only justice to testify that Blackpool has never fallen behind in the march of improvement. The Electric Lighting Act was then passing through the Committee stage in the House of Commons, under the guidance of Mr. Chamberlain; and Mr. Chew and many others were most anxious that, when it passed, the obligation of undertakers to maintain a supply of gas would be rescinded. The Brush Companies were then in the heyday of their short-lived prosperity, and Hammond and Co., Limited, had just been floated, greatly to Mr. Chew's disgust.

To Mr. Chew's credit it should here be mentioned that in those days he lifted up his voice boldly—being a Corporation officer—against the unfairness of charging such a high figure for the interest on municipal gas capital. He declared that: "If the capitals of so many companies and "corporations can only be brought to bear a rate of interest "that is now ruling the Money Market, it will not be one "town alone that will supply gas at 1s. 9d. per 1000 cubic "feet, with 5 per cent. interest on capital expended, and "nothing taken off the price to go in relief of rates, and "new and improved apparatus erected at a less cost than "formerly." It would also be necessary, in order to compete with electricity, to produce a cheap and good quality of gas "suited for all the various uses to which it will be hereafter "applied." Mr. Chew was here among the prophets.

Curiously enough, however, the prepayment gas-meter not being known, the body of professional opinion so well represented and expressed by the Blackpool Gas Engineer was inclined to give petroleum the preference as the poor man's light. When the oil was brought to the cottager's door, and retailed in the smallest quantities at ridiculously low prices, and when the lamp was so cheap, Mr. Chew did not believe the working man would "trouble the gas com-"panies much." He did not regret it; for, what with one thing and another, this class of customer was more trouble and expense than he was worth. The idea that the cottager would ever want to cook by gas had evidently never entered into Mr. Chew's philosophy. The late Dr. Siemens took part in the discussion of the paper, and expressed his surprise at the author's sentiments in respect to the poorer class of gas consumers. He, at any rate, was not prepared to give up this kind of trade to the oil-sellers; and he protested that the difficulty of collecting payments ought not to weigh with gas companies to the extent of inducing them to discourage the use of gas by the poor. Mr. Chew was obstinate—saying in reply that: "It might be that in the time to come, when "the City of Hygeia was founded, the habitations of the "poor would all be lighted by gas." The City of Hygeia has yet to be built; but tens of thousands of homes of the poor know the benefit of gas.

At the period in question, the Crystal Palace Electric and Gas Exhibition, with all its consequences, was still in the future; and Mr. W. Sugg was imploring the London Gas Companies to support this now historic venture with more readiness than they had yet manifested. We joined in the appeal; but found some excuse for the Companies in the circumstance that they had just spent largely of their available resources in support of the Smoke Abatement Exhibition of the previous winter! We still have a smoke abatement movement on foot; but it would be difficult to say how much positive progress it has made in all this time. Nineteen years ago, the Clamond incandescent gaslight was being exhibited before the French Gas Managers' Society; and Mr. William Richards was disputing with Mr. Lewis for priority in discovering that platinum wire gauze would give a brilliant light in the flame of a gas blowpipe under high pressure.

A comparison of the bulk of the present number of the "JOURNAL" with that of the thousandth number will serve to indicate the amount of the growth and development of the gas industry during the interval. Although neither the industry nor the "JOURNAL" has changed fundamentally during this period of time, both have broadened out, and, let us hope, improved. We wish to claim that as the increase and strengthening of the gas industry as a whole has proved beneficial to the community, so the regular means of publicity offered within the technic of the industry by the "JOURNAL" has benefited the industry itself and those who live by it. This is sufficient distinction for any technical periodical; and we do not think that so much will be denied us by the majority of our regular readers, or even by some with whom we may not always have been in perfect agreement. Complete unity of opinion is very nice on the whole, no doubt; but in every-day life it is apt to mean deadly dulness of conversation. Controversies are often fruitful of fresh ideas, and lead to new advances. We have had many polemics in the "JOURNAL" in past times, and hope to have some more, to the stimulation of thought and the inspiration of endeavour.

The International Engineering Congress.

THE International Engineering Congress, to which engineers from all parts of the country and from many places abroad, were flocking a little more than a week ago, is now a matter of history; but fruits of a ripe character remain to be gathered in. When the compilation of the proceedings of the nine Sections into which the Congress was divided is completed, the volumes will present to the world a record which will have a potent bearing in very many directions. Science, engineering, and industry have been participants in the benefits which have accrued; and there is no turgidity of imagination in saying that, from this copious source, profit will flow to all races of mankind. Light has been thrown on many questions; and the rays have penetrated into much obscurity. The bonds of the base of the engineering profession have also, we gladly believe, been strengthened by the intercourse of the various branches. This is an effect of such congresses; bringing as they do the various units into intimate contact.

Another good work may also have been accomplished through the instrumentality of the newspapers of the country. The more important ones have taken note of the proceedings, and to a sufficient extent, we trust, to remove from the minds of the public the idea that the engineering trade of

this country is now a decaying one. Even if it is, in some branches, we do not find it to be so in the gas engineering trade. The Congress, at any rate, proves that, generally speaking, the engineering industry of the country has working heads who are not a whit behind their compeers of other countries in technical prowess and execution. This being so, there should be, through the Congress and the publication of information concerning its work, a clearing away of much "popular ignorance" as to the nature of the work of engineers, of the "lack of appreciation" of their class, and of the "stubborn refusal of the English spirit to admit the "necessity of any formal qualification on the part of those "who claim to be of the profession"—all of which are points over which the President of the Congress, Mr. James Mansergh, raised a lament in the course of his Inaugural Address, the delivery of which on Tuesday, in the Bute Hall of the Glasgow University, ended with a signal mark of the appreciation of the audience.

The prosperity of the Congress, taken as a whole or sectionally, was due to the enthusiasm of all who were concerned in it—from the Honorary President (Lord Kelvin), the President (Mr. Mansergh), right through the long list of Vice-Presidents and Committeemen, until we come to the General Secretary (Mr. J. D. Cormack) and the Honorary Secretaries of the Sections, of whom Mr. James W. Helps was one. On Mr. Cormack and the Honorary Secretaries, the brunt of the work fell; and they did it thoroughly well. The proof of their enthusiasm and success is found in the numbers of engineers who were attracted to Glasgow; in the ideal variety and quality of the technical matter provided for discussion; and in the resulting ingathering of opinions, experience, and ideas upon the multiplicity of subjects presented for the consideration of the Sections—all of which guides one to an exact perception of the position of the technical engineering knowledge of to-day. In this successful result, those whose enthusiasm originated the Congress, and those who worked in an equally enthusiastic spirit for its accomplishment, have their recompense.

In regard to the Gas Section, its work is fully dealt with elsewhere; and therefore there is little upon the actual proceedings which need be said here. The opportunity, however, cannot here be resisted for stating that we rejoice—and the gas industry generally will do so—with the Chairman (Mr. George Livesey), the two Vice-Chairmen present (Messrs. W. Foulis and W. R. Herring), and the Hon. Secretary (Mr. Helps) on the solid and useful character of the proceedings, and upon the felicity permeating the whole of the time devoted to the conference. May it not be hoped that, in the theatre at Glasgow in which gas engineers of divided opinions upon a subject which could not have missed crossing their minds sat under a comfortable feeling of fraternity, birth was given to a renewed desire to bring about that blending which would give to the gas profession the dignified rank in the engineering world which is enjoyed by other branches of the profession?

There is one other thing we shall look for as a product of this Congress. It is that the high measure of success which was attained in the Gas Section will be maintained in the work of the technical organizations of the industry. The Congress should be a stimulus to greater things than we have had during the past year or two. A bitter cry has gone up from Secretaries and Committees regarding the penury of the industry in technical matter for discussion. New work, thoughts, and ideas are to be drawn from last week's proceedings in Glasgow. Let the profession, then, take full advantage of them, and let apathy be displaced by earnest and fruitful work, to the honour of the workers and the advancement of the industry.

Sir William Thomas Lewis on the Coal Question.

Of the numerous addresses delivered at the Glasgow Congress last week, not the least interesting was that read by Sir W. T. Lewis, as the President of the Mining Section. Sir William—who is well known as one of the veterans and most influential men in the coal industry—after referring with satisfaction to the steady decrease in the mortality incident to coal-mining, remarked that the improvements which had helped to reduce the accidental deaths from 19 per million tons raised in 1851 to 4 per million tons in 1900, had at the same time imposed great additional expense; so that the cost of producing coal had been permanently increased, notwithstanding the very extended application of machinery. Comparing present operations with those of a similar kind forty years ago, there was a permanent increase in the cost of coal-getting of at least 30 per cent. This is a very serious matter, and renders all the more imperative the extended adoption of machinery for coal-cutting, in order that this country may not be unduly handicapped in its commercial rivalry with other nations.

We are glad to see that Sir William Lewis drew attention to our backwardness in respect of coal-cutting machinery as compared with America, where the number and output of the machines in use have increased, and are increasing, enormously. Sir William is inclined to be pessimistic as regards the competition of American coal with British in distant parts; and, in view of the extent to which Australian, Japanese, and Native Indian coal has of recent years displaced British coal in markets east of the Suez Canal, he considers the prospect of our maintaining the volume of our export trade, "to say the least, doubtful." Whatever our views as to whether a reduction in the export trade would be desirable or the reverse, everyone will agree with Sir William that "it is of greater importance than ever that "British employers and their workmen should co-operate in "adopting the best mode of working our collieries, so as to "raise the coal in the most economical manner, and in the "best possible condition." The speaker could do no greater service to the industry and to his country than that of converting the general body of miners to this view. We should then see a less wide discrepancy between the number of tons raised per annum per person employed in the United Kingdom and in the States.

The address proceeded to refer to the enormous waste in the working of the various seams of coal, and to the losses incurrred (1) through such large quantities of small coal being made in working, (2) through so great a proportion of that small coal being left underground in some districts, and (3) through the neglect of the thin seams. "So many "seams of coal had been entirely lost through the working "of the superior and most profitable seams alone, that he "regarded the matter of such supreme national importance "as to justify special legislation if necessary." Sir William referred to the possibilities of more economical consumption of coal—pointing to the saving effected during the past thirty years in the fuel consumption in the boilers and engines of steamers, as an example of what could be accomplished. The average consumption of fuel per horse-power per hour in steamers has been reduced from 2·11 lbs. in 1872, to 1·83 lbs. in 1881, to 1·52 lbs. in 1891, and to 1·48 lbs. in 1901. But "we are far from enjoying one-half "the economies which experts consider might still be made "in the use of coal for steam purposes," and such economies, "coupled with the husbanding of our coal resources by a "substantial reduction of the waste in the working of our "coals, would extend the duration of our coal resources so "as to provide for all our requirements, and maintain our "commercial position as a nation, while amply providing "for the protection of our country, for a much longer term "of years than any of the recent estimates on the subject."

The address indicates directions in which the labours of the proposed Royal Commission may with profit be applied; and we are glad to think that Sir William Lewis is certain to have a considerable share in those labours.

Meeting of the Association of Chambers of Commerce.

The autumn meeting of the Association of Chambers of Commerce of the United Kingdom was held in Nottingham last week, under the presidency of Lord Avebury, who was able to pronounce an encouraging judgment on the general state of the national trade. The President expressed himself with much caution on the vexed question of German progress and encroachment upon British trade supremacy, which he thought had been forced, and had probably been dearly bought. It is difficult for an English Free Trader to sympathize with the essentially artificial German commercial system; and it would be more than could be expected of human nature for Lord Avebury to have passed over without slightly complacent comment the last unfavourable Diplomatic and Consular Report upon the condition of German industrial enterprise. An exceptional feature of the meeting was an outburst of a Nottingham delegate, bearing the not very English-looking name of Stiebel, against the British fiscal system; but he was not well received by his colleagues. The principal speaker at the annual banquet on Wednesday was the Home Secretary, who had the remarkable advantage of being in a position to boast that the new coal tax had been approved by the Association. Indeed, so strong was the feeling of the majority of the meeting on this head, that

Mr. Ritchie was able to say that he should have the pleasure of assuring the Chancellor of the Exchequer that, instead of a shilling, he might have had half-a-crown a ton for the asking. The truth of the matter is that the coal trade of the country has so antagonized every other by its rapacity during the past two years, that the representatives of colliery districts at the meeting had a rough time of it—and "serve "them right," as most consumers of coal would be ready to cry. Many other questions of interest were brought before the meeting, among others that of the desirability of improving the canal transport arrangements of the country by the formation of Canal Trusts. This is a matter upon which the "JOURNAL" has held and expressed strong opinions. Unfortunately, the meeting was obliged to confess that parliamentary business has fallen into such a condition that the measures favoured by the Association, however desirable in the best interests of the trading and industrial community, have no chance of passing. This consideration lends an academic air to much of the proceedings of such Associations.

Trade Union Congress and the Taff Vale Railway Case.

THE Trade Union Congress is in luck this year in having something serious to talk about. It was high time for a justification of the existence of this popular institution, which had become very shaky of late. As "The Times" most pointedly, if pompously, put it, "the proceedings of the "Trade Union Congress, which of late years have often de-"generated into the discussion of abstruse points of economic "and political theory by imperfectly informed persons, were "concentrated" upon a very practical question. This was the decision of the House of Lords in the Taff Vale Railway case, which is generally recognized as having completely altered the status of Trade Unions. Whereas in the past these societies, whether registered or unregistered, have freely expended their large pecuniary resources upon labour conflicts in the serene assurance that, whatever injury they might inflict, they could not be held liable for damages, they have now been rudely awakened from this pleasant dream of irresponsible power. Henceforward, when a representative member of a Trade Union Executive rides the high horse, his supporters will have to pay the incidental expenses. No wonder this discovery has spread great consternation among the whilom admirers of the Havelock Wilsons, and Bells, and other "new" Union wire-pullers. It was one thing to allow these gentry to play at being potentates at their own risk, which did not amount to much. But when it is understood that for every slander spoken or libel put in circulation by an official, the whole funds of the Union will be answerable, the case will be greatly altered. It is right to acknowledge here the reasonable and, on the whole, sensible way in which the change of circumstances was received by the Congress and its ruling body, the Parliamentary Committee. There was no foolish outcry against the highest tribunal of the country, which has thus dashed to the ground the pride of many a strike agitator. The Committee took the very prudent course instead of consulting Counsel as to the effect of the Taff Vale Railway decision; and they received the warning that the position is a very serious one. Counsel plainly states that "it will be exceedingly difficult to conduct "a strike with any degree of success without doing illegal "acts." In return, the Unions probably have the shadowy consolation that they might conceivably sue "a vindictive "employer, who might try and break up or otherwise injure "a Union for his own benefit." Such an employer, when found, might also be kept and exhibited in a glass case; for his like has never yet been seen.

Some of the professed friends of Trade Unionism, who are more Unionist than the members themselves—such as Mr. Frederic Harrison—are going about protesting that the House of Lords judgment has ruined Trade Unionism for good and all. It will occur to most people that an institution which cannot live in conformity with the laws of this country had better die as quickly as possible. If Trade Unions cannot endure the degree of amenability to the law of the land to which every British subject is born, they can have no place in this law-abiding community. But we do not believe that the great majority of sensible workpeople, who constitute the directing power in the best and soundest Trade Unions, will be content to be identified with any outlaw society. They have shown this by falling in with their Counsel's suggestion, that on the first opportunity a picketing case shall be taken to the House of Lords, in order that it may be ascertained what the law is in regard to the one remaining strike manœuvre which can be carried out by concerted action. This is wisdom. Also, the Congress has been wise in not crying after the unattainable in the form of special legislation to alter the law as set out by the House of Lords. The clean sweep made of professional Labour candidates at the last General Election warned politicians of this type that the constituencies do not want them; and there is not the remotest chance that the Legislature will deliberately intervene to place Trade Unions in a position of irresponsibility before the law which only this order of rejected candidates desire.

The rest of the proceedings of the Congress does not call for much comment. Most of the standing dishes of Labour politics were brought forward and duly discussed. Several fresher subjects were available to smarten up "the feast of "reason and the flow of soul" at Swansea, including a little abuse of Lord Penrhyn, which could do the Bethesda quarrymen no good. An American delegation assured the meeting that, notwithstanding all reports to the contrary, the steelworks strikers in that Land of the Free are "resolute, loyal, "and hopeful, and only wanted loyalty of self-interest from "the brothers of the trade, and the sympathy of other "workers." Their wants are small. But, to all intents and purposes, the Taff Vale Railway case overshadowed the whole gathering. What was left out of the shade was mere politics, and of a particular stamp at that. Altogether, though the presence of misfortune of a concrete kind noticeably chastened the orators of the Congress, it did not tend to improve the quality of the miscellaneous resolutions, which were moved and passed with the monotonous regularity of an automatic vote-recording machine.

Prize Subjects in Applied Science.—The programme of subjects for which prizes will be awarded by the Société Industrielle de Mulhouse next year has been issued, and copies can be obtained on application to the Secretary of the Society. "Nature" says that medals will be awarded for an electric motor, the power and driving rate of which can be easily varied; a memoir on the comparative cost of electricity and gas for lighting a town having a population of at least 30,000, and the comparative costs of electricity, gas, acetylene, and water gas for lighting an industrial establishment; also for the best memoirs or works on the theory of the manufacture of alizarine reds and the composition of aniline blacks. Money prizes as well as medals are awarded for some of the subjects, and all the competitions are open to every one, irrespective of nationality. The memoirs, designs, or models submitted for the awards should be sent to the President of the Society, Mulhouse, before Feb. 15, 1902.

Manchester District Institution of Gas Engineers.—In a previous issue of the "JOURNAL," it was intimated that, owing to Grantham (at which the 127th quarterly meeting of this Institution will be held next Saturday, under the presidency of Mr. Charles Wood, of Bradford) involving a long journey for some of the members, arrangements were in progress for forming an advance party, to reach the town on Friday evening. These have been completed; and they are fully explained in the programme issued by the Hon. Secretary (Mr. J. Wilkinson, of Drighlington). This party will be met on their arrival by Mr. Shadbolt, who has taken charge of the local arrangements; and on the following morning he will accompany them in visits to Messrs. Hornsby's Agricultural Implement and Engineering Works, the gas-works, and other places of interest. Luncheon will be served at the Angel and Royal Hotel, after which coaches will pick up the party arriving from Manchester, and all will drive to Belvoir Castle, the seat of the Duke of Rutland. On returning, the members and friends will take tea together, on the invitation of Mr. Shadbolt; and afterwards the meeting will be held. The business will consist simply of the election of two new members and a conversation on the subject of interchangeable meter-unions.

Repairing a Submerged Main.—A 36-inch ball-and-socket joint on a submerged main across the Hackensack River, forming part of the water-works of Jersey City, was pulled open some weeks ago, probably by the anchor of a vessel, and its repair was a tedious job. The operation has been described in the "Engineering Record." A heavy anchor was first fixed about 200 feet to one side of the joint and connected by tackle with the pipe. The end of the rope was carried to a hoisting-engine on a scow, or raft, and by this means the ends of the main were gradually drawn back approximately into place. The work was done very carefully, in order to avoid starting other joints; and as the divers were unable to see, on account of the muddy condition of the water, each stage of the operations was necessarily slow. When the ends of the joint were again in place, a heavy iron sleeve, cast in upper and lower halves with flange connections, was bolted over the joint, and caulked to the two pipes. As the caulking progressed, the pipe was gradually drawn back into its place, and when the work was finished it was found to be perfectly tight under a pressure of 55 lbs. Rings of strap iron were then placed about the ends of the sleeve, to keep the end in position and connected by iron tie-rods. When the work was completed, it was at once put in service under 75 lbs. pressure, which has been steadily maintained up to the present time without signs of leakage.

INTERNATIONAL ENGINEERING CONGRESS IN GLASGOW.

SECTION VIII.—GAS.

MR. GEORGE LIVESEY, M.Inst.C.E. (President).

A REVIEW OF THE PROCEEDINGS.

The Glasgow Exhibition has so far been a remarkable success, both financially and in the numbers of visitors it has attracted to the city from all parts of the country and abroad. As in the case of the Paris Exhibition of last year, it has had, and is having, as concomitants, conferences of great technical bodies, which have also attained to a high-pitched level of success; and not the least productive of good has been the International Engineering Congress of last week. All told, there was an attendance of engineers on the opening day estimated at about 2500; the various ranks of the profession being represented to a degree far beyond expectation. This large influx of engineers into Glasgow—the majority of whom were accompanied by ladies, tested severely the accommodation which Glasgow can offer to those desiring a temporary habitation within its borders. But notwithstanding the fact that the city has, under the normal conditions prevailing during the Exhibition, a large and constantly changing accession to its population, the Local Committee who undertook the laborious task of providing for the "billeting" of the sudden inflow last week were highly successful in their arrangements, though some of the visitors had of necessity to be located in quarters a little removed from the city and the neighbourhood of the University, which, by the magnanimity of the Senate, was devoted to the work of the week.

Most travellers know the beautiful University buildings; and nowhere could there have been found a place more suitable for a large scientific gathering than this historical centre of learning. Ample rooms were available for all purposes—for the transaction of all the executive work attaching to the Congress, and for the convenience of the members; and the Lecture Theatres supplied the best of accommodation for the meetings of the various Sections, of which there were nine, and which again were representative of no less than 27 British technical organizations and a number of foreign Societies. In Section VIII., which was the only one in which our readers are intimately interested, were amalgamated the Institution of Gas Engineers, the Gas Institute, and the North British Association; and there was representation from about seven foreign Societies. The delegates of the latter were cordially welcomed; chief among them being M. Cornuault, Dr. Leybold, and Herr J. O. V. Irminger.

No good would result from an attempt to survey the whole of the labours of the Congress in the "JOURNAL"—in fact, while the attempt might be made in good spirit, the outcome could but be, from the very immensity of the work accomplished, very imperfect. With an acknowledgment of the faithfulness and completeness with which those who undertook the work of organization discharged their duties (with particular mention of Mr. J. D. Cormack, the General Secretary), we will pass to such days of the week as call for notice here. The first function in connection with the Congress took place on Monday evening, when a banquet was given by the Chairman (Robert Caird, Esq., LL.D.) and the Executive Committee to the London Committee, Foreign Delegates, and Honorary Members. About 300 guests were present. The speeches accompanying the toasts were of a high order. In one, the Earl of Glasgow, glancing over the work which the Congress had before it, reminded those present that, of the nine Sections, three of them represented branches of engineering which could not have had existence at the beginning of last century. This was true, because then there were no railways, gas, or electricity; and other branches of engineering were simply carried on by rule-of-thumb. Another century, however, has been ushered in; and, as the work of last week testifies, the highest intellects are being used to improve and increase our manner of production in the different courses of engineering. The quality possessed by gas and electricity of protecting life and property was acknowledged, in the course of a speech, by the Lord Provost of Glasgow (Dr. Chisholm).

But Tuesday morning witnessed the actual opening of the work of the Congress, when the President, Mr. James Mansergh, received the foreign members, delegates, and others in the magnificent Bute Hall of the University. The Inaugural Address of Mr. Mansergh which followed had been indited with a broadness of thought which spread its interest and applicability to all classes of the profession. He lightly skimmed over quite a number of interesting points. In one place, referring to the definitions of engineering which have been framed, he alluded to the persistence of much popular ignorance of the nature of engineering work, the lack of appreciation of engineers as a class, and the stubborn refusal of the English spirit to allow the necessity of any formal qualification on the part of those who claim to be of the profession. While admitting that an engineer cannot ever be too deeply instructed or too well trained in all the elements of knowledge and skill required for the effective pursuit of his calling, the President made the assertion, which few will gainsay, that the really great engineer is born and not made. He thought the nature of the work of engineers would be much better recognized among ordinary people (who are careless of etymologies) if the name of their avocation were spelt in English, as it is in languages of more pronounced Latin derivation, with an "I" instead of "E"—say "Ingeniering" in place of "Engineering." However, giving up the quest for the missing definition of engineering, he passed on to declare—and again no one is likely to attempt to controvert him—that real engineering must be mastered as it is realized on works in progress. It has no authoritative text-book. Among other of his brilliant pithy truisms, he stated that the distinguishing note of modern engineering is that it subserves in the main the interests of the mass of the people. Allusion was made by the President to the alarm which has been sounded in our ears of late, warning us that we have touched the high-water mark in respect of the prosperity derivable from the prosecution of those manufacturing industries which are based upon engineering, or served by it with the means of transport and communication. But whether or not the alarm and warning are justified, Mr. Mansergh could not say. The question of moment to Britishers is: Shall we maintain our ground, to say nothing of increasing our lead? Here, again, the President—being, like the rest of humanity, incapable of foretelling future events—could not give answer. But this he does believe, "that the character of the future of the country and the fruitfulness of our common calling depend chiefly on the preservation of that freedom for the play of all the talents, all the energies, all the force of human initiative for the subjugation of the powers of Nature and their direction in the service of mankind, which has enabled us to do so much in this regard in the past. While there cannot be too much technical education, the President holds liberty to be more precious than learning. The fullest freedom for the exercise of the inborn spirit of initiative, enterprise, and adventure, is the next essential to the occurrence of this spirit in the individual members of a race, for the whole to make headway in the universal struggle for life and a leading position. Parenthetically, Mr. Mansergh remarked upon how much of the real essence of economical engineering is contained in the work of settling standard sections of important constructive materials. At the conclusion of his address, the President dismissed the large gathering to the work of the various Sections.

Just before eleven o'clock, gas engineers from all parts of the British Isles and from abroad began to assemble in the Natural History Theatre, which had been allotted to the work of Section VIII.; and the tiered seats were soon fairly well occupied. (And here it may be mentioned that the membership of the Section—and nearly all must have been in attendance at the opening sitting—was above 150, with 80 ladies accompanying. The applications in the first place by foreign members numbered 19.) Recognized through his personal sterling qualities and worth as the chief of the gas engineering profession, it was not astonishing that Mr. George Livesey, on his entry into the room, should receive a greeting of remarkable warmth from all; nor that on his countenance should be traced a gleam of the satisfaction which he felt, and which any man would have felt, under like circumstances. Accompanying him was Mr. Mansergh, who stayed to hear the address of his old friend and contemporary in another branch of engineering. On taking the chair, Mr. Livesey had on his right-hand side Mr. William Foulis, and on his left Mr. W. R. Herring—two of the Vice-Presidents. Unfortunately, Mr. T. O. Paterson, who

as the President of the Gas Institute at the initial stages of the Congress, was also a Vice-President, was unable to be present. The Honorary Secretary, Mr. James W. Helps, also occupied a seat at the President's table. Mentioning the names of Mr. Helps and Mr. Foulis brings to mind their devotion and labours, during several months, in the cause of ensuring that the Section should issue from the work of the week abreast with the best of the other Sections. That success has rewarded their efforts is disclosed by the distinguished quality of the matter composing our "General Report" to-day.

Without delay in unnecessary formality (other than a few courteous words of welcome to the foreign delegates), Mr. Livesey delivered his opening address, which was published in the "JOURNAL" issued the same day. Mr. Livesey did not indulge in any rhetorical flourishes; but he shaped his address with that simpleness of expression and clearness of thought that are characteristics of all his oral utterances or his writings. How much this natural lucidity in the presentment of his views is answerable for the rapid advancement of the best interests of the gas industry of late years, no one can tell. The address was short; and it was compounded out of subjects which Mr. Livesey has made his own—among others, the testing of gas and its price, the triple partnership, the prosperity of the great gas industry, and the maintenance of the supply for it of men who will put heart and brains into their work. His concluding sentences contained a few words as to the unsatisfactory relations of public authorities with gas companies; and he has given gas-works owning authorities one method by which they may estimate the advantage the gas engineer confers on the community he serves, a proper appreciation of which should ensure to the engineer the adequate treatment he deserves.

There was no business to occupy the attention of the Section other than the reading of papers; and as there were no less than ten on the list to be pressed into something short of eight hours, the President and his deputies (Messrs. Foulis and Herring), during their occupancy of the chair, did not allow the time to be frittered away. The paper by the Committe on the lighting of the Exhibition was taken as read; and M. Fernand Bruyère's paper on "Gobbe's Process for the Production of Water Gas" met with a like fate, owing to the absence of the author. Then came Professor Vivian B. Lewes's paper on "Water Gas as an Adjunct in the Manufacture of Coal Gas"; and in this there is matter of a freshness which should lead to a widespread and vigorous research. The paper gives the results of an actual working investigation, at the Crystal Palace District Gas-Works, into the idea propounded by the Professor in his lecture before the Institution of Gas Engineers last year—that was, the utilization of water gas in the destructive distillation of coal. For the results, reference must be made to the paper. They are promising, and to an extent that urges further trial. Experiments are needed with a variety of classes of coal; and only the co-operation of engineers, with water-gas plants in different districts, can ensure the thorough prosecution of the inquiry. We have seen the plant with which the experiments were made at the Crystal Palace Gas-Works; and all the fitting up that is requisite is of an inexpensive character. This, the offer of help by Professor Lewes, and his conviction that, as the investigations proceed, "the possibilities of enriching water gas with illuminating hydrocarbons that are at present lost in the formation of tar, will exceed the most sanguine expectations," should result in the work being taken up with energy at the close of the coming winter's pressure. Already Mr. Herring has plant fitted up in Edinburgh; and he has placed it at the service of Professor Lewes. The variety of coals with which Mr. Herring deals should produce some interesting results. The gas industry are indeed indebted to the Professor, Mr. Livesey, and Mr. S. Y. Shoubridge, for the work already done in this regard. The final paper read on Tuesday was by Mons. A. Rothenbach on an automatic lighting and extinguishing apparatus, the actuating mechanism of which is clockwork. It is feared that expense and the vagaries of our climate will check its general adoption in England. However, Mr. C. C. Carpenter thinks that the system of lighting and extinguishing lamps in vogue in this country is wrong, cumbersome, and expensive; and that a change must be looked for in the direction indicated by M. Rothenbach. It is hoped that trials of the apparatus will be carried out here, and that the gas profession will be made acquainted with the experience gained.

The first paper on Wednesday was contributed by Heer J. van Rossum du Chattel; and it described "The Principles of the Construction of a Modern Gasholder for Amsterdam." Requirements peculiar to the situation rendered necessary the building of a tank through which trains loaded with material could pass in different directions, as well as the provision of a store-room. For purposes of study and consultation where similar conditions prevail, the paper and the diagrams (into which the author put a considerable amount of work) will be useful; but we are afraid there would be some little scruple on the part of English engineers before adopting the principle. Nevertheless they welcome M. du Chattel's learned thesis. The voluminous statement which followed, and which had been prepared by Dr. Schniewind (who, however, was unable to be present, but was ably represented by his friend Dr. G. Révay), on the subject of the "Production of Illuminating Gas from Coke-Ovens," gave some valuable information on the progress which has been made in the United States and Canada in recovering illuminating gas from bye-product coke-ovens. No one would be more pleased than gas engineers if the publication of the paper resulted in a trial being made in this country under the conditions here prevailing. Of more immediate value, perhaps, is the paper by Dr. Leybold on the pressing question of the electrolysis of pipes. It elicited some apposite remarks from Mr. Gisbert Kapp, which adds to our knowledge of the means adopted in Germany for keeping electric currents under restraint, and protecting occupiers of the subsoil of streets. Mr. Livesey's appeal that information should be sent to the South Metropolitan Gas Company immediately on a case of electrolysis coming under observation, in order that an examination may be made by experts on the spot before the removal of the injured member, should be noted by both gas and water engineers.

The remaining three papers were taken on Thursday, and they provided material for a full morning's work. Mr. C. C. Carpenter's argument in favour of the "Application of the Unit System of Gas Manufacture to its Purification" offered a good subject for discussion; and opinion was much divided. Mr. W. R. Chester, dealing with "The Transport of Material in Gas-Works," gave a great deal of statistical matter, which will enable engineers who have not already adopted mechanical means of conveyance in their works to make comparative computations which may induce them to institute a change. Last, but far from least in value, was the paper by Mr. W. R. Herring on the "Construction of Inclined Retort Carbonizing Plants." The author lays bare the views which have guided him in adopting certain principles in the construction of the magnificent inclined retort installation at Granton. On account of this and his recognized authority on the subject, the paper is of considerable worth, and it ranks high in the proceedings of the Section. Nearly the whole of the papers produced excellent discussions, regarded from the point of view of quality and not extent.

The technical matter provided in the other Sections was extensive, varied, and of a high standard. As in the Gas Section, the sittings only occupied the mornings. The afternoons were spent in specially arranged visits to large and interesting works in Glasgow and the surrounding district. The weather was fine; and the visits were exceedingly well patronized. Mr. Foulis gave a numerous party of the members composing the Gas Section a delightful treat on Tuesday afternoon, both at Dawsholm and Provan; and an account of the visit will be found elsewhere. The Furnace Gases Company, Limited, gave entertainment and instruction to many of the members on Wednesday afternoon; and an informal inspection of the gas exhibits was made on Thursday, after the close of the sittings. On Wednesday, Thursday, and Friday, there were organized excursions to the lochs and places of interest in the West Highlands, and to other delightful spots within easy reach of Glasgow, for the ladies and those members who preferred delectation of this order to the much more prosaic visits to works. Large parties took advantage of these opportunities of making themselves acquainted with some of the grand scenery of Scotland.

Among the social functions was a reception, on Tuesday evening, at the City Chambers, by the Lord Provost and the other Magistrates. There was a brilliant assemblage of ladies and gentlemen, to the number of about 3000. The salons and corridors were decorated for the occasion, though in themselves beautiful without any extraneous adornment. After the reception, brief speeches were delivered in the Banqueting Hall. High-class music, vocal and instrumental, was a feature of the entertainment.

We cannot close this necessarily cursory review of the

week's doings without recording the inauguration of the James Watt Laboratory, by Lord Kelvin, on Tuesday. The Laboratory adjoins the University, of the Engineering Department of which it will form an important and valuable adjunct. It is, however, yet in an uncompleted state. The Bellahouston Trustees made the munificent grant of £12,500 towards the building; and it is expected that £14,000 will be required in its equipment, of which £12,500 has already been subscribed. The President of the Congress has shown his appreciation of the work by the presentation of a cheque. We compliment the originators on their successful achievement in this scheme for elevating the training of engineering students. Testing-machines have already been installed; and later the gas-engine presented by the North British Association of Gas Managers will be brought into service, and stand as a memorial of Murdoch, whose work produced the means which made possible the existence of such motors.

GENERAL REPORT.

The sittings of Section VIII. (Gas) commenced on Tuesday morning, in the Natural History Lecture Theatre of the Glasgow University. Mr. GEORGE LIVESEY, the appointed Chairman, presided.

THE INAUGURAL ADDRESS.

The CHAIRMAN, who on rising was very heartily greeted, said this was not the time for ceremony, but for business; and he would therefore proceed at once. His first word, however, must be one of welcome to those gentlemen who had paid them the great compliment of coming from foreign lands—from the sister nations across the Atlantic, and from the Continent of Europe—to attend the Congress. British gas engineers were greatly indebted to them for their interest; and he had no doubt they would feel even more so when they had read their papers. Another remark which he wished to make was that, in his address, there was nothing sacred—nothing like a sermon above or beyond criticism. If there were any sentiments or remarks which members could advantageously criticize, he should be glad indeed to hear the criticism. The order was for short addresses; but he was afraid the one he had prepared was rather longer than it should be.

The address (which was published in last week's issue) was then delivered; but no one took advantage of the opportunity to discuss it.

THE THANKS OF GERMAN COLLEAGUES.

Dr. LEYBOLD (Hamburg) interpolated a brief acknowledgment as the representative of the German Association of Gas and Water Engineers. He said that, when the invitation to the Congress arrived from the Institution of Gas Engineers, the German Association were highly pleased; and it was unanimously decided at the annual meeting in Vienna to send a member of the Committee to Glasgow. He was delighted to say that this honourable mission had fallen upon him; and he took the liberty of offering, in the name of the German Association, their most respectful thanks for the invitation. It was a matter of course, as also of the greatest importance, that the German gas and water engineers should follow up all the novelties in connection with the two industries in England. There were at the present time in Germany many new gas and water works in course of construction; and they gladly made use of all the experience gained in England, in order to execute those works in as practicable a manner as possible. The use of gas in Great Britain was considerably more developed than in Germany—in the manufacturing world as well as for household purposes. It was indeed surprising to find that, even in small towns, there were gas-works of enormous dimensions. He was convinced himself that there was so much of interest to be seen and to be learnt that his colleagues were glad to make use of the opportunity of inspecting English gas-works. Last year they had the privilege of welcoming some members of the British Institution of Gas Engineers at Berlin; and they showed their visitors all the arrangements there. He hoped those gentlemen had gained the impression that in Germany the gas and water industries were now on a high level of development. A further expression of thanks led to the concluding remark that he hoped the meeting would take a satisfactory and interesting course.

The CHAIRMAN said they were going to get over one of the papers more quickly than he had anticipated. It was a contribution by the Committee on the lighting of the Exhibition; and it was proposed that it should be taken as read. It was a subject they could not well discuss; but the lighting itself was exceedingly interesting to see.

The paper (accordingly taken as read) was entitled—

NOTES ON THE VARIOUS SYSTEMS OF GAS LIGHTING IN USE AT THE GLASGOW INTERNATIONAL EXHIBITION.

There are four systems of gas lighting in use—

1. The Welsbach high-pressure incandescent system.
2. The Scott-Snell self-intensifying gas-lamp.
3. Kitson's incandescent oil-light.
4. Acetylene gas.

The Welsbach High-Pressure Incandescent System.—The installation of the Welsbach high-pressure incandescent system extends from the Bank Street entrance to the main entrance of the Exhibition Buildings, and along the length of the main building as far west as the Art Galleries; the total area of ground illuminated being about 20 acres.

There are 140 cast-iron ornamental columns, each surmounted by a single lantern of the Welsbach "shadowless" pattern, and containing a cluster of three burners, consuming 30 cubic feet per hour at a pressure of 8 inches; the illuminating power from the cluster being 1000 candles. There are also 12 columns each carrying three lanterns, and 10 columns each with five lanterns; each lantern being fitted with three burners in a cluster as above described. There are in all, therefore, 162 columns carrying 226 lanterns, and containing 678 burners, giving a total illuminating power of 237,000 candles.

The gas consumed is about 10 cubic feet per hour for each burner; and at the price of 2s. 6d. per 1000 cubic feet, the total cost for the gas consumed in the whole installation amounts to rather less than 17s. per hour.

The compressing plant consists of two sets of Keith's patent "Duplex" automatic gas-compressors. The motive power is water, drawn from the street mains, and the working is entirely automatic. Each set of compressors consists of two pumping cylinders, with the motors fixed on the top, combined with a regulating arrangement for controlling the gas pressure and the speed of the motors and pumps. The quantity of water used is 0·86 gallon per 10 cubic feet of gas. At the price of 4d. per 1000 gallons, the cost of water for compressing 1000 cubic feet of gas is therefore 0·34d.

The special mains laid in the grounds for the high-pressure gas are divided into two sections, with a bye-pass valve between them, so arranged that either set of compressors can be used to supply either section or all the burners.

It is estimated by the Welsbach Company, who have supplied the lanterns and burners, and who maintain the burners, that the mantle renewals will not exceed 12 per burner per annum. Welsbach Kern high-pressure burners are used throughout. These require no chimney.

The lighting is very effective. In any part of the area lighted, small print can be read with ease.

The Scott-Snell Self-Intensifying Gas-Lamps.—Between the Prince of Wales' Bridge and the new Exhibition Bridge, on the north-west bank of the Kelvin, 32 lamps have been erected by the Scott-Snell Self-Intensifying Gas-Lamp Company, Limited. Each lantern contains one burner. The pressure of the gas is raised in the lamp itself by the waste heat of the flame.

The lanterns used are square, and are provided with a special governor immediately under the burner; and this maintains a constant pressure at the burner of 8 inches. The gas consumption of each burner is 10 cubic feet per hour, giving an illuminating power of about 330 candles.

The self-intensifying arrangement is placed on the top of the lantern, but cannot well be described without reference to drawings. In close proximity to this installation, the Company have a show-room, where diagrams and the working of the lamps may be seen and explained.

Kitson's High-Power Incandescent Oil-Lamps.—The Kitson Lighting and Heating Syndicate, Limited, have erected in the eastern portion of the grounds, extending from the south-east bank of the Kelvin and including the area where the Japanese, Canadian, and Russian sections are situated, about 100 columns, each carrying a single lantern with two burners in each. The light from each lantern is stated to be of 1000-candle power.

The system consists of the combination of an oil-burner and incandescent mantle. The oil (which is a specially prepared, highly refined, hydrocarbon oil, having a flash-point of about 110° Fahr.) is stored in steel cylinders placed in the square base of the columns. The oil is first vapourized by the heat of the flame. It is then burned in incandescent burners with mantles. Air is pumped into the oil receiver until a pressure of about 50 lbs. per square inch is obtained. This forces the oil through small copper or bronze tubes to a vapourizing tube, where it is vapourized by the heat from the mantles; the arrangement being such that only a minute quantity of oil is subjected to the heat at one time. From the end of the vapourizing-tube, the oil vapour passes into a mixing-tube on the top of the reflector, where sufficient air is drawn in for supporting combustion. The mixture then travels down to the burners, where it is burned inside a mantle as in incandescent gas-lamps.

The consumption of oil is stated to be 0·1 gallon per hour for 1000 candles. With oil at 9½d. per gallon, and including renewals of mantles, &c., and time and attention to the lamps, the cost is stated to be less than 1d. per 1000 candle-hours.

The Bon-Accord Acetylene Gas Lighting.—The Bon-Accord Acetylene Gas Company, Limited, have erected a plant for 220 lights of 25-candle power each; and the Press pavilion, band stand, and Flint's Tea Rooms (all situated in the eastern portion of grounds) are lighted by acetylene gas.

The carbide of calcium used is that manufactured at the Falls of Foyers in Inverness-shire. The carbide containers are of cast iron, and are set in a rectangular tank of wrought iron and steel, surrounded by circulating water, which ensures the gas being given off at a comparatively low temperature. From these containers, the gas passes to the holder, thence to the acid washer, and forward through the purifiers and regulator to the distributing mains.

The automatic generators only produce the gas according to the supply required.

The Home and Colonial Acetylene Gas Lighting.—The Agricultural Hall and Home Farm Buildings are lighted by the Home and Colonial Acetylene Gas Syndicate, Limited. The plant selected for this section is M'Conechy's non-automatic or storage system. The gas is made during the day, and held in store until required. By this means, the moisture is eliminated, and burner troubles are unknown.

M'Conechy's patent generator is of the "drown" order. The water used to work off the carbide is contained within a jacket round the top of the generator, and its flow is controlled by a tap on the outside. The carbide chamber is sunk into a well of water, and is square in form. The carbide container is round, and perforated with holes. As the water slowly rises round the container, the gas evolved escapes through the holes, and percolates through its own residual—namely, the thick lime water; and it is thereby thoroughly purified. The carbide container is placed in the centre of the square chamber. The removal of the residual is both cleanly and easily effected, as the square chamber has handles; and, by lifting the manhole cover, it is quickly cleared out.

The gas made by this system is said to be free from all trace of odour when burning. Several portable lamps are shown; and they are automatic in action.

The Manchester Acetylene Gas Lighting.—Messrs. William Moyes and Sons, of Glasgow, Agents for the Manchester Acetylene Gas Company, Limited, have a 60-light machine at work, consisting of Kay's acetylene gas generators and Frank's purifier. The plant is very compact. Besides lighting their own show-room, the model cottages of Messrs. Lever Bros., Limited, some distance away, are lighted from the same apparatus. Here also are shown a number of the "Phos" acetylene lamps and burners.

The Patent Paraffin Gas Lighting Company's Exhibit.—An oil-gas plant capable of supplying fifty lights is in operation, belonging to the Patent Paraffin Gas Lighting Company, Limited, of Glasgow. The gas is made from crude shale oil; and it is stated that from 12 gallons of oil, 1000 cubic feet of 60-candle power gas can be obtained. It is used with Welsbach incandescent mantles, as well as with open-flame burners.

The CHAIRMAN said, as the papers were being distributed, it was hardly necessary to read them if the authors were not in attendance. The author of the next paper—Mr. Fernand Bruyere—was not present; and he (the Chairman) proposed that the course suggested should be pursued in the case of his paper. Having taken the opinion of the meeting on the point, he remarked that the paper dealt with an interesting matter. Continuing, he said the next paper could not be taken as read. It was by Professor Vivian B. Lewes; and it dealt with "The Utilization of Water Gas in the Destructive Distillation of Coal."

The above-named and the rest of the papers were taken in the following order:—

Tuesday.—(1) "A Supplement to the Manufacture of Carburetted or Uncarburetted Water Gas." By FERNAND BRUYERE. (2) "The Utilization of Water Gas in the Destructive Distillation of Coal." By VIVIAN B. LEWES, F.I.C., F.C.S.

Wednesday.—(3) "The Automatic Lighting and Extinguishing of Street Lanterns." By A. ROTHENBACH, jun., of Berne. (4) "The Principles of Construction of a Proposed Modern Gasholder for Amsterdam." By J. VAN ROSSUM DU CHATTEL, of Amsterdam. (5) "The Production of Illuminating Gas from Coke-Ovens." By F. SCHNIEWIND, Ph.D., of New York. (6) "Destruction of Gas-Pipes by Means of Electricity." By Dr. W. LEYBOLD, of Hamburg.

Thursday.—(7) "The Application of the Unit System of Gas Manufacture to its Purification." By. C. C. CARPENTER, M.Inst.C.E. (8) "The Mechanical Transport of Materials in Gas-Works." By W. R. CHESTER, M.Inst.C.E. (9) "The Construction of Inclined Retort Carbonizing Plants." By W. R. HERRING, M.Inst.C.E.

Some of the papers, with the discussions thereon, appear elsewhere; the remainder will be given in due course.

On Thursday morning—after the conclusion of the discussion on Mr. Herring's paper, some votes of thanks were passed, in

ACKNOWLEDGMENT OF SERVICES.

Mr. FOULIS said this finished the technical part of their proceedings; and he was exceedingly sorry the Chairman was not able to address the members in concluding the sittings, because he (Mr. Foulis) was sure he could have said to them a great deal more, and said it a great deal better, than he himself could do. He thought they must all agree that they had had an exceedingly successful meeting—in fact, he believed it was the most successful meeting that he ever remembered attending. This was a result which would give them all a great deal of gratification. There were just one or two duties to which it was only right they should attend before parting. In the first place, they could not leave (and he believed it had been arranged to do this in all the Sections) without recording their hearty thanks to the University Authorities for so kindly placing the whole of the College buildings at the disposal of the Congress. He moved a resolution accordingly.

Mr. W. R. HERRING said he had been asked to second this vote of thanks to the Senators of the University. They were indeed much indebted to them for having put such a convenient and handsome room at the disposal of the Gas Section.

The motion was unanimously carried.

Mr. CHARLES HUNT said it gave him great pleasure to propose a cordial vote of thanks to the contributors of papers. It was obvious that the success of a meeting like this depended in the first place upon the quantity and quality of the compositions offered for discussion; and in this respect their highest expectations had been fulfilled. He quite endorsed all that Mr. Foulis had said with regard to the great success of the meeting. He was sure he had never had the pleasure of listening to a more practical series of papers. They were, he thought, especially indebted to the gentlemen who had come from abroad at great personal inconvenience, and who had imparted to them new ideas, which he was sure all the members would take home and study to advantage.

Mr. JOHN WEST (Manchester) seconded the motion. It had, he said, been a most admirable meeting; and he did not certainly remember ever having attended a much better one. They heartily recognized the time and trouble which their friends from abroad had spent in coming to Glasgow to confer on matters of value in connection with the manufacture of gas. A number of their English brethren, too, deserved their warmest thanks. At that morning's sitting, they had had two papers on subjects over which he had

spent a considerable amount of time; and those two papers had been very admirably handled. He was speaking of the mechanical portion of the papers; and for himself individually he thanked the authors very much. From the commencement of the sittings, there had been nothing but harmony, and everything had been conducive to pleasure, happiness, and utility. They came there for the purpose of utilizing everything they possibly could. They had had there quite a brotherhood; and really on this occasion they had somewhat excelled themselves. (Laughter.)

The motion was heartily agreed to.

Mr. WILLIAM KING (Liverpool) said he had to propose that the best thanks of the members be given to the gentlemen who had so ably presided over their deliberations. This would commend itself to all present. They were indebted to Mr. Livesey in the first place for his address. When he spoke or wrote anything, he always gave them something to think about, although perhaps they might not always see exactly the same as he did over various questions. (Laughter, in which Mr. Livesey heartily joined.) With regard to Mr. Herring, he had been not only present at the meetings, but he kindly rendered important service to many of them in the earlier part of the week, when he devoted himself to them with great assiduity, and afforded them much pleasure in the inspection of his new works. Then what should he say of their other Vice-President, Mr. Foulis? He (Mr. King) was sure he was only expressing the views of the members when he said that the success of the meetings had been largely due to what Mr. Foulis had done for them. He had been absolutely unsparing in doing everything possible not only for their comfort, but for their instruction. And for a long time before they came to Glasgow this meeting must have occupied his thoughts; and he must have been exercised indeed in getting everything into the splendid order he did for their reception. Therefore in an especial manner their thanks were due to him; and they would be ungrateful indeed if they had left Glasgow without making this acknowledgment.

Mr. J. HEPWORTH (Carlisle) said he had been asked to second the motion which had been proposed. He was sure everyone in the room was only waiting to endorse in the heartiest possible manner the very appropriate allusion Mr. King had made to the gentlemen who had taken part in the meeting as Chairman and Vice-Chairmen. He was sure he was quite within the truth when he said that the eminent success of the Gas Section of the International Congress was assured from the moment that it was known that Mr. Livesey was to preside over the meetings. He was one of the few men who not only brought honour to himself in a position of this sort, but conferred honour infinitely more.

The vote was carried by acclamation.

The CHAIRMAN said, on behalf of himself and his two friends (although he should like them to reply afterwards), he felt that all he could say was that they thoroughly appreciated the great kindness of the members, and the manner in which Mr. King and Mr. Hepworth had referred to the vote. In acknowledging the great assistance that Mr. Foulis and Mr. Herring had rendered during his (Mr. Livesey's) absence from the chair, he said that the success of the meetings had been largely due to the former gentleman. He believed, in fact, it was due to his inception that the Gas Section was introduced. Then there was another duty that he had to perform; and it was to propose a vote of thanks to their Honorary Secretary (Mr. J. W. Helps). Second to Mr. Foulis, there was no man who had done so much for the Gas Section as Mr. Helps. He (the Chairman) happened to know the amount of time the Honorary Secretary had given to the work, and the amount of correspondence that was necessary; and he thought the success that had attended his efforts was the best proof that could be adduced of the extent of the endeavours Mr. Helps put forward. He had been most unsparing of himself; and in his present position, he (the Chairman) could sympathize with him very deeply. They were indeed greatly indebted to him for the work he had done.

Mr. FOULIS thanked the members for their vote and Mr. King for the kind words he had said about him. However much the work had been in connection with the meetings, it had been to him a great pleasure, and it was certainly to him a satisfaction that the meetings had proved so successful. He should like to say further that he did not think any of them could appreciate as he could the amount of labour that had fallen upon Mr. Helps in making arrangements for the meetings. It was not only the labour since the meetings commenced, but that which was required for some months before. He heartily seconded Mr. Livesey's proposal.

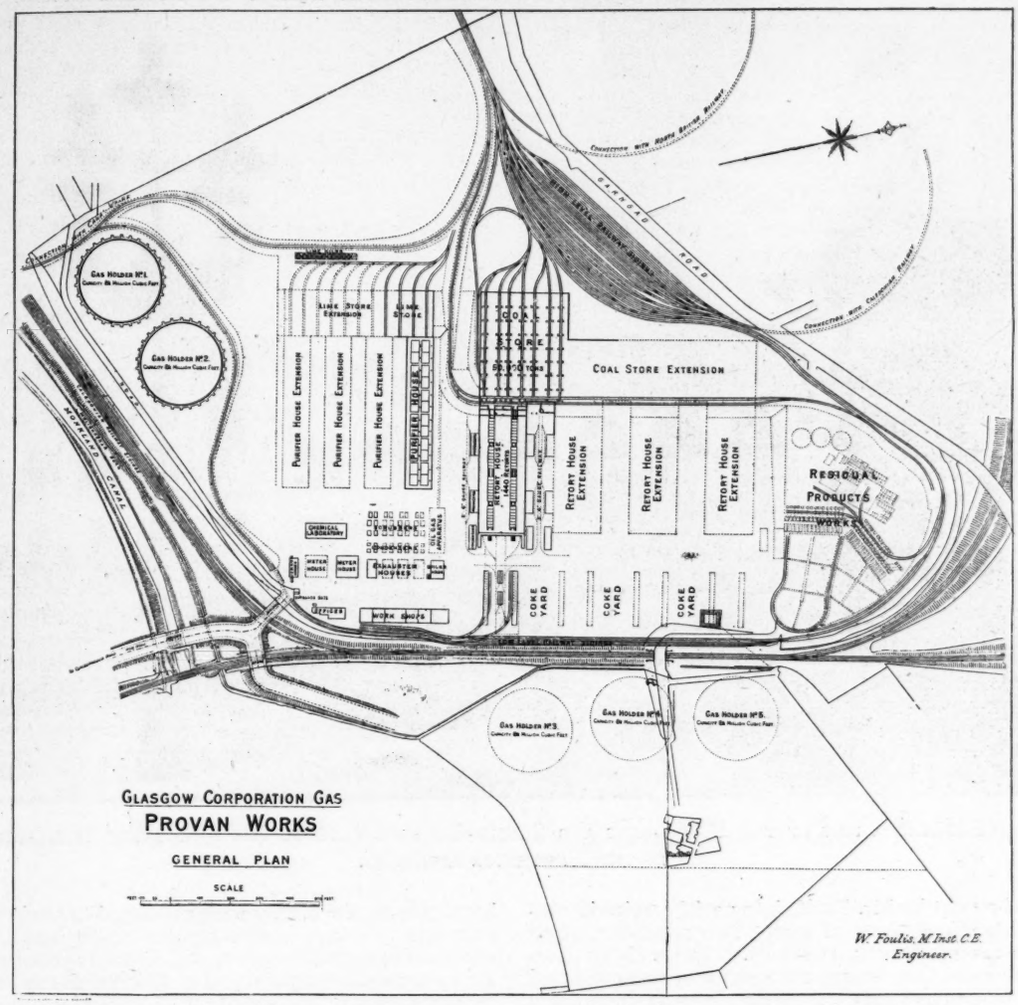
Mr. HELPS, who was received with enthusiasm, acknowledged the kind words which had been spoken as to the manner in which he had performed the duties of Honorary Secretary to the Section, and the heartiness with which the vote had been carried. He need say very little more than practically repeat what Mr. Livesey had said, that really his (Mr. Helps's) reward was in knowing and seeing that his efforts had been crowned with success. He seemed to have heard on all sides the opinion expressed that the meetings had been a success; and if they bore favourable comparison with other Sections, he wanted no more reward than that. He added that, if any gentleman wished to make any remarks on the papers, if they would address them to him, he would have them inserted in the proceedings of the Section.

THE DAWSHOLM AND THE NEW PROVAN GAS-WORKS VISITED.

Of all the excursions during the week, the one which was provided on Tuesday afternoon by the Gas Committee of the Glasgow Corporation and their Engineer (Mr. W. Foulis) possessed the greatest amount of interest for the members of the Gas Section. The visit to the old-established works at Dawsholm and those at Provan which are merely in an embryo stage at present—only the walls and chimney stacks of the first retort-house, and the walls of the coal-store having been erected, with the tank of one holder in a well-advanced stage, and other preliminary work undergoing rapid execution—was really to all a technical treat. In the old works, they saw many of the fruits of the labours and research of the Engineer-in-Chief, and-at the latter they witnessed an example of true engineering in the subservience of awkward levels to the promotion of economy in the work of gas manufacture.

But to begin at the beginning. By the time the special train drew up at the starting-point—Kelvinbridge Station—at 1.15 on Tuesday, there was quite a large muster of gas engineers who were anxious to visit the works. A few minutes' ride brought them to Dawsholm, where the retort-houses almost monopolized attention. The Arrol-Foulis stoking machinery could not be seen to better advantage anywhere than in these spacious houses; and they were performing their duties in a manner which proved their efficiency. But Mr. Foulis did not allow his visitors to stay long over them, as he had something in the way of outside producers to show, which were of especial interest; and, as no doubt he expected would be the case, they were the subjects of much inquiry. There are four of these producers; and they deal with the whole of the 192 retorts, of 9 feet in length, in one of the houses. About 30 per cent. of the production of coke is used as fuel in these producers. Some surprise was expressed by a few of the party as to this percentage. But it is not an astonishing matter when it is known that the coke used contains over 20 per cent. of ash; and the producers were specially designed to deal with this ashy fuel. The blowing-in of steam prevents it clinkering. The gas made is a kind of semi-water gas, containing 12 per cent. of hydrogen, rather over 24 per cent. of carbonic oxide, and only 3 or 4 per cent. of carbonic acid. Each producer deals with four settings of 12 retorts each. A large dust-catcher for freeing the producer gas was also examined with interest. The settings were found to be equally heated top and bottom. It was explained that in the settings there is nothing like a combustion chamber. The combustion is simply carried on among the retorts; and it is kept going on by the way the air and gas are brought together. As Mr. Foulis put it, the air and gas are sent seeking each other, and are not brought together like a blowpipe flame.

Leaving Dawsholm, the visitors were conveyed by rail to Provan, which is about 4½ miles from the city. The rugged site, and Mr. Foulis's ingenious method of dealing with it, formed the subject of conversation from the time the members first espied it. But before they were allowed to wander over it and examine the work in progress, the Gas Committee entertained them to a sumptuous luncheon in a temporary building. At the head of the tables sat Bailie Mitchell, the Convener and Chairman of the Corporation Gas Committee, and Bailie W. Fife, the Vice-Chairman. Other members of the Committee, with Mr. George Livesey, Mr. Foulis, Mr. Helps, and others occupied places of honour. Intermingled with them—and the act of courtesy was much appreciated—sat the foreign representatives; one of them

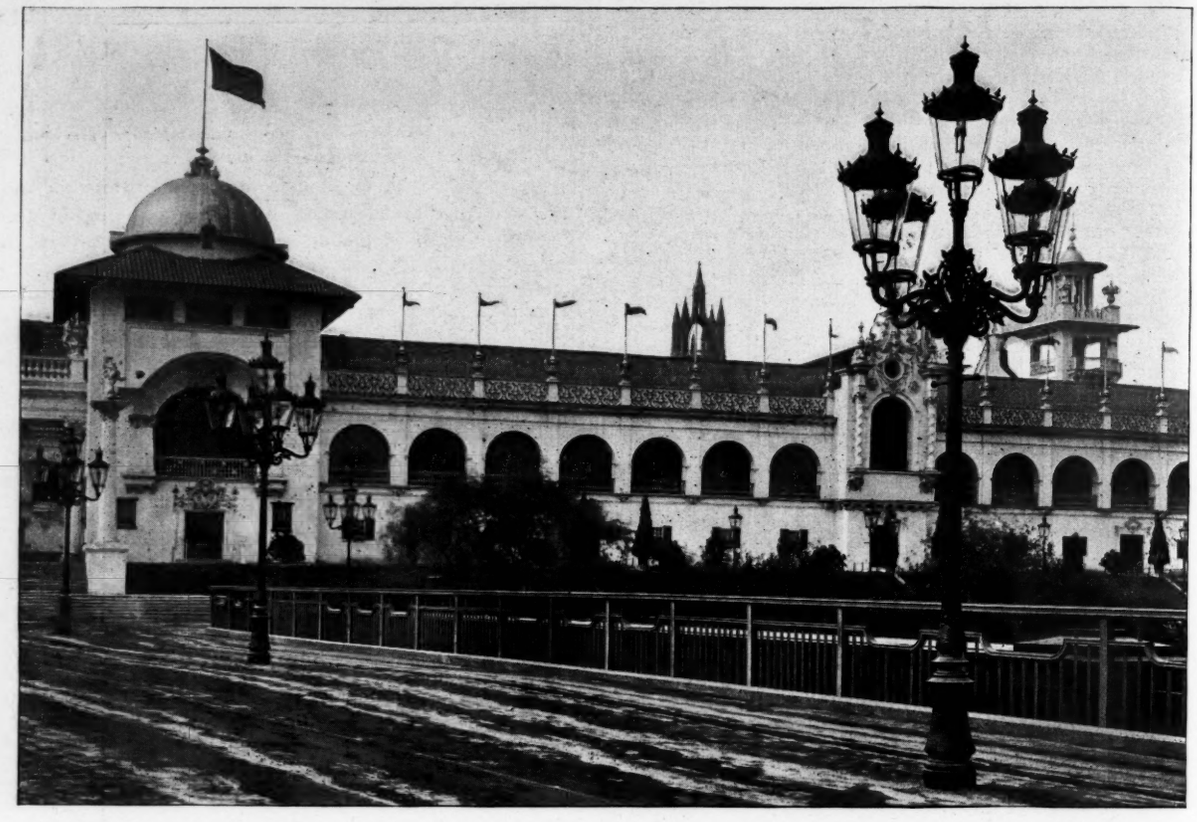


being M. Cornuault, who it will be remembered was the Acting-President of the Société Technique on their recent visit to this country. The repast over, Bailie Mitchell gave the visitors a hearty welcome in the name of the Lord Provost and the Corporation of the city. Mr. Livesey, in a few words, thanked Bailie Mitchell and the Corporation for their distinguished reception. He added that the members of the Gas Section of the Congress were greatly pleased with the large gas-works which were owned by Glasgow; and they were delighted to have such substantial evidence that the Corporation did not consider that the days of gas-works were numbered, as they had in the fact that the Corporation had purchased 120 acres of land for new gas-works, and were putting on it such extensive buildings. He could not close his remarks without saying a word about Mr. Foulis. They were all very proud to find he was as highly respected and beloved by his Committee as he was by all his professional brethren. Bailie Mitchell, acknowledging these remarks, said they were glad to have been able to show the works to a body of men who were so well able to judge of what they were doing. As Mr. Livesey had said, they were proud of their Engineer, Mr. Foulis; and they sincerely hoped he would be long at the head of this great department of the Corporation. Mr. Foulis was called for, and was received with enthusiasm. He expressed his thankfulness to both Mr. Livesey and Bailie Mitchell for the kind words they had used respecting himself. M. Cornuault also expressed his appreciation of the generous reception which had been accorded him and his colleagues; and he drank to the union of the gas industries of England and France and all countries abroad.

On leaving the luncheon-room, the visitors repaired to an adjoining apartment, where Mr. Foulis explained the plans. Before mentioning a few points picked up during the walk round the works, a short statement which was circulated among the visitors may be reproduced. It was as follows:—

The increase in the quantity of gas manufactured in the three gas-works belonging to the Corporation during the last thirty years is shown by these figures: 1871, 1,421,618,000 cubic feet made; 1881, 1,966,922,000 cubic feet; 1891, 3,508,633,000 cubic feet; 1901, 6,121,367,500 cubic feet. The existing works have been extended from time to time to their utmost limit, to meet the increasing demand, and the construction of additional works has become necessary. In 1898 a site for new works was selected at Provan, which included the lands of Easter Blochairn, and a portion of Blackhill and Germiston Estates; this being on the whole the most suitable of the many sites examined. The principal difficulty experienced in the selection of a site arose from the necessity of getting a piece of ground of sufficient extent entirely free from coal workings. In the session of 1899, a Bill was introduced into Parliament to empower the Corporation to purchase these lands, and to erect gas-works thereon. The Act was obtained in August, 1899, and the construction of the works was commenced in January, 1900. The area of the site is 131 acres. It is conveniently situated for both railway and canal communication. The levels are somewhat irregular; but in designing the works advantage has been taken of the difference in levels to facilitate the transference of material. The coal, lime, &c., will be brought in at a high level, and the coke and other materials sent away at a low level. The works, when completed, will be in four sections, each section forming an independent works, which will be capable of manufacturing 12 million cubic feet per day, or a total of 48 million cubic feet. Only the first section is being constructed at present. This will consist of two retort-houses, 387 feet long by 78 feet wide, each containing 720 retorts; a coal-store having a capacity equal to 50,000 tons; a purifier-house, 503 feet long by 85 feet wide, with lime-store; also boiler, exhauster, and meter houses, offices, workshops, &c., and all the necessary apparatus. There will likewise be two gasholders, each capable of containing 8½ million cubic feet. A works for distilling tar and ammoniacal liquor will be erected at the north-west corner of the site. The tar liquor will be pumped direct from the gas-works to these works, as produced. Railway siding accommodation will be provided sufficient to deal with 4000 tons of material daily. The total length of the railway lines inside the works will be about 8 miles; and in addition there will be about five miles of 2 ft. 6 in. gauge lines for conveying coke, waste lime, &c. The bricks used in the construction of the works are being made from clay found on the site, thus not only saving the cost of carriage on the bricks, but also utilizing the materials excavated, which would otherwise have to be removed from the site. Excellent puddle clay is also obtained for the gasholder tanks, and an abundance of excellent building sand is being excavated at several places on the site.

Now, as has already been said, the difficulty that the Gas Committee and Mr. Foulis had was in getting for their new works sufficient ground of adequate size at a suitable level anywhere near Glasgow; and the levels on the site purchased vary considerably. But the great differences in level



VIEW SHOWING A FEW OF THE FIVE-LIGHT AND SINGLE-LIGHT WELSBACH HIGH-PRESSURE GAS-LAMPS IN THE EXHIBITION GROUNDS.

have been brought by Mr. Foulis into useful service in connection with the delivery of coal. The retort-house and coal-stores are continuous buildings. The railway lines come to the end of the latter; and from that point the coal can either be dropped into the stores, or be brought down right through the store and tipped automatically into coal-breakers, from whence it is elevated or conveyed through the immense retort-house, and distributed to the hoppers. In addition to this, provision is made, by introducing a couple of lines at the side, to facilitate unloading the coal direct sideways. The coal delivery is really a question of gravity from the high-level to the low. There is a difference of level from where the high-level railway comes in to the retort-house floor, of 30 feet. The producer floor is 10 feet below the retort-house floor; and the producer floor and the coke-yard are on the same level. The coal-store floor is 13 feet above the retort-house floor. The measurements of the retort-house and coal-store have already been given in the official description; and the plan will give further information. The contractors for practically the whole of the buildings on the works are Messrs. Robert M'Alpine and Sons, of Glasgow. Their contract includes excavating works and the gasholder tank; and they are making all the bricks required on the site. The contract for the retort-house and coal-store roofs has been let to Sir William Arrol and Co., Limited, in conjunction with the Barrowfield Iron-Works Company, Limited.

The large gasholder tank, which is nearly half its height up, or about 25 feet, was inspected from the elevated sides; and in magnitude and solidity it strikes the onlooker as being a magnificent piece of work. It is 284 feet in diameter, and will accommodate a three-lift holder, each lift being 50 feet deep. As already stated, the holder will have a capacity of 8½ million cubic feet. The excavation for the second gasholder tank has just been started; and in style and dimensions, it will be exactly the same as the first one.

The visitors left the busy scene about 4.30, and reached the Central Station in Glasgow about 5 o'clock.

TREATMENT OF WASTE GASES FROM BLAST-FURNACES.

On Wednesday afternoon, members of the Gas Section to the number of about forty visited the works of the Carnbrae Chemical Company, where, in addition to being very hospitably received, they were privileged to see in operation processes of a very interesting and instructive order. The plant which they saw was erected in 1891 by Messrs. R. & J. Dempster of Manchester, and is designed to treat the waste gases from the blast-furnaces of Messrs. Merry & Cunninghame, Limited; the amount of gas so treated averaging about 36 million cubic feet daily. Similar plants have been erected by the same makers for dealing with the blast-furnace gases at the Shotts Iron-Works, the Govan Iron-Works, the Calder Iron-Works, Glengarnock Iron-Works, and the Langloan Iron-Works. It consists primarily of dust-boxes, condensers, washers, scrubbers, and separators, along with the tar and ammonia plants for working up the recovered tar and ammoniacal liquor. The gas is drawn from the furnaces into the main gas-tube, and from there through the dust-boxes, where the dirt that has been carried over from the furnaces in suspension with the gases is deposited along with some 80 per cent. of the tar. The dust is deposited mainly in the first or inlet section, and is run out along with the tar into a small settling tank, where the sediment is deposited; the tar being allowed to run forward into the store-tank. On leaving the dust-boxes, the gas passes through the condensers. There are two sets of these, each consisting of 144 wrought-iron tubes, 20 inches diameter and 55 feet high; the whole being supported on cast-iron boxes arranged with partitions for giving the gas the full travel of the condensers. The condensed tar and the ammoniacal liquor are taken off by trapped overflows, and conveyed from there to a separator, and forward into their respective store-tanks.

The temperature of the gas on entering the condensers averages from 150° to 200° Fahr., and on leaving from 60° to 70° Fahr. The tubes are cooled externally by means of water sprays. After leaving the condensers, the gas passes through the exhausters. Each exhauster is composed of two steam cylinders and four gas cylinders, and is capable of passing 550 cubic feet of gas per revolution; their design being such as to draw off the gas in a very steady manner. From here the gas is forced through the washers. There are four of these, sealed with the overflow liquor from the scrubbers; their own overflow or seal being regulated by patent slide-valves. This overflow runs to a separator, where the tar and ammoniacal liquor are divided and run to their respective store-tanks. After leaving the washers,

the gas is put through the scrubbers. These are three in number, and consist of cast-iron towers, 120 feet high by 18 feet diameter, and are filled with thin boards about 7 inches wide set on edge; each layer being set crossways to the next. The gas passes through each of these three in turn. In the first two it meets, and is scrubbed with, the ammoniacal liquor which is pumped to the top and distributed over the whole area of the scrubber. In the last one, it is scrubbed with fresh water, and here the last traces of ammonia are taken out. The scrubbers are supplied with suitable water-valves for bye-passing any one as required. The clean or washed gas after leaving the scrubbers is taken to the heaters and boilers at the iron-works, and also to the tar stills and boilers of the recovery plant. The average yield per ton of coal since the starting of the plant ten years ago has been: Sulphate of ammonia, 22·67 lbs.; pitch, 119·8 lbs.; oil, 7·3 gallons.

THE GAS EXHIBITS.

Thursday afternoon and evening were devoted by many of the members to an inspection of the gas exhibits in the Exhibition, and particular attention was devoted to the lighting. Regarding the latter, it seems a great pity that the Exhibition authorities, with a view doubtless to the decoration of the already highly illuminated grounds, should have taken it into their heads to run hideous looking cables (bearing small incandescent electric lamps) from lamp-post to lamp-post in the area covered by the Welsbach high-pressure incandescent gas lighting. Now that the evenings are drawing in, these brilliant lamps would be seen under conditions that they have not hitherto enjoyed; and the authorities are really spoiling a good exhibit by their action. This is hardly fair after the expense to which both the Welsbach Company and the Water Motor and Automatic Liquid Elevator Company, Limited (who own the Keith compressors), were put to in laying down their installations. The lighting of the Exhibition was fully described in the "JOURNAL" for April 30 last; and a special article was devoted to the high-pressure gas lighting. It is therefore unnecessary to repeat any of the information we then gave. But for the interest of those readers who have been unable to get to Glasgow, we give a view showing four of the large posts bearing five lanterns, and the single lamps running along the front of the building are seen in the distance.

Cement for Stone Joints.—A French authority says a good cement to form the joints of stones round water reservoirs consists of: Litharge in fine powder, 5 parts; minium, 4 parts; sifted road dust, 100 parts; oil, 9 to 10 parts. This cement is said to become gradually white, and in a few months to acquire the colour of quarry stone.

Mr. Price-Williams on Coal Statistics.—Just as the present number of the "JOURNAL" was going to press, we received from Mr. Price-Williams a letter in reply to the criticism in the first of the "Editorial Notes" last week, of his letter to "The Times" of the 31st ult. We regret, therefore, that it has to be held over till the next issue. In the meantime, we take the opportunity of correcting two errors which escaped notice in the article referred to. The population figures quoted from Mr. Price-Williams's letter were given as 31,955 and 35,087 millions. These, as the calculation immediately following showed, should have been 31·955 and 35·087 millions.

Laying a Submerged Pipe-Line.—A 12-inch submerged pipe-line was recently laid across Shirley Gut, in Boston Harbour, under the direction of Mr. F. A. M'Innes, one of the staff of the City Engineer. The lengths of pipe were put together on shore, then placed on planks supported on rollers, and securely fastened to a hawser in such a way that the strain was largely borne by it. The main was 408 feet long, and contained 34 flexible joints. It was pulled across the channel by means of a steam-winch; and as the pipe entered the water, empty oil-barrels were attached to it, so as to reduce the friction of the pipe as it was dragged over the bottom. The pipe was placed in a dredged channel about 5 feet deep; and when it was over its final location, the barrels were cut loose by a diver. It took an hour and forty minutes to pull the main into its place. When tested after the work was done, the line was found to be practically tight. The difficulties under which this work was performed, says the "Engineering Record," were unusual, inasmuch as the current in Shirley Gut runs exceedingly fast, and the period of slack water is short—about five minutes. The pipe used was an inch thick, weighing about 1820 lbs. per 12-foot length. It was of special design; the spigot being turned to a true spherical form, and a raised ring in the bell or hub being turned to fit the curvature of the spigot. There were two lead scores in the bell. This design causes the lead to remain in the bell in whatever position the joint lies; making comparatively easy the operation of calking a joint under water in case of a leak.

UTILIZATION OF WATER GAS IN THE DESTRUCTIVE DISTILLATION OF COAL.

By Professor VIVIAN B. LEWES.

[A Paper read before the Gas Section of the Engineering Congress at Glasgow.]

Last year I had the honour of bringing before the Incorporated Institution of Gas Engineers a review of recent Continental developments in the use of water gas, and pointed out the changes in practice brought about by the altered conditions in consumption, the increase in the price of gas, coal, and oil, and the cheapening of benzol; and I concluded the paper by making certain suggestions as to the use of water gas, which seemed to me, from laboratory experiments, to be full of promise.

Shortly after this, Mr. George Livesey, with that generous helpfulness which he has always shown when anything likely to advance the interests of the great gas industry was in question, gave permission for a trial of the suggested process at the Crystal Palace District Gas-Works, and placed me in the hands of Mr. Sydney Y. Shoubridge, to whom I am deeply indebted, not only for the able and thorough way in which the experiments were carried out, but also for the scientific interest which he has throughout taken in the results; and it is a matter of deep regret to me that his health this summer has left the preparation of this paper to me rather than to Mr. Shoubridge, to whom the credit of the work is due.

In order to make clear the objects of the experiments, it is necessary to briefly recapitulate the chain of events which led up to them. The heavy tax on oil, and its consequent price on the Continent, has severely militated against the introduction of the beautiful process of making carburetted water gas introduced by Lowe and perfected by Messrs. Humphreys and Glasgow and others; and even in our own country, and to a less extent in America, fluctuations in the price of oil have seriously interfered with the advance of the process. Under these conditions, several Continental works tried the experiment of mixing blue water gas with the coal gas, and then carburetting the mixture up to the requisite candle power by benzol, the cheapness of which, owing to the recovery plant now fitted to most coke-ovens, rendered it available for this purpose.

A still further step forward was then made by introducing blue water gas into the foul main; and this was found to give a slightly better result, as the water gas took up some of the hydrocarbon vapours which otherwise would have condensed with the tar, and a small saving resulted in the quantity of benzol needed for the final enrichment.

I pointed out in my previous paper that the formation of tar during the destructive distillation of coal was due partly to the distillation from the coal of hydrocarbon vapours which afterwards condensed as liquids in the tar, and partly to decompositions and interactions taking place in the upper part of the retort among the hydrocarbons which were there subjected to contact with the heated crown of the retort and to the action of radiant heat, with the result that many compounds which would have been of value as illuminants in the gas became broken down into methane, hydrogen, and carbon.

It is also clear that as the gas and vapours generated from the coal near the mouth of the retort have only a few inches of heated area to travel, and are hurried out of the retort by the gas behind them, they will leave it almost unchanged; while the gas from the extreme end of the retort, having nothing to drive it forward, will be over-baked and decomposed until it has hardly any illuminating value, but yields a large percentage of the naphthalene found in the tar and mains.

All the experimental work which I have done during the last twenty years on the analytical and synthetical actions of hydrocarbons under the influence of heat, has pointed to the wonderful influence which dilution has in checking such actions; and in the paper to which I have already referred, I suggested that if a stream of water gas could be passed through the crown of the retort during the process of carbonization, the dilution and hurrying forward of the coal gas so induced would prevent the secondary reactions from taking place, and thus a considerable gain in candle-feet per ton of coal carbonized might be hoped for.

Within a few weeks of the publication of the paper, one of the most important events in the history of gas lighting

took place in the passing of the South Metropolitan Gas Act of 1900, by which the standard illuminating value of the gas supplied to London south of the Thames was reduced from 16 to 14 candles, showing that our legislators had at length awakened to the fact that the interests of the consumer were best served by a plentiful supply of cheap gas of moderate illuminating power; and there is no doubt that this must be the general tendency of all gas legislation in the future. So that high-power gas will soon be a thing of the past, and 12 to 14 candle gas will universally take its place.

At the last half-yearly meeting of the South Metropolitan Gas Company, it was stated that, although the standard illuminating power had now been reduced to 14 candles, the returns from the testing-stations of the London County Council showed that the gas sent out still had an illuminating power of over 15 candles, and that this unnecessarily high-quality gas continued to be made owing to the fact that the Company's Engineers had not yet learned the conditions necessary for the economical production of the 14-candle gas. This must of necessity be a grave trouble wherever the change has to be made; and I hope that, in the experimental results which I have to bring before you in this paper, you will recognize a solution of the difficulty that is at once simple, practical, and economical.

The experiments at the Crystal Palace District Gas Company's works at Lower Sydenham were commenced in July, 1900. The coal used was Derbyshire, and was from the same pit throughout the experiments. The yield of gas and candle power given by the coal was tested on a large working scale before, during, and after the water-gas experiments; and the results taken by Mr. Shoubridge as the standard for comparison were, under ordinary conditions of carbonization, 10,468 cubic feet per ton of 15·88-candle power gas.

It is manifest that, in order to compare the value to the gas manager of varying volumes of gas of different candle power, the only convenient and practical method is to reduce the values to candle-feet, obtained by multiplying the make by the candle power and dividing by 5, when a direct comparison can be made; and with this coal the result is

$$\frac{10{,}468 \times 15{\cdot}88}{5} = 33{,}246 \text{ candle-feet per ton.}$$

The plant used in the earlier experiments consisted of six beds of seven retorts each, and later of twelve beds of seven retorts; the section of all retorts being 22 in. by 16 in. and 20 feet long, heated by regenerative furnaces and charged by power stoking machinery. The gas from them was passed through one complete section of the works separately, and was therefore condensed, scrubbed, purified, and measured in the usual way—the ordinary gas manufacture being carried on at the time, in other sections of the works.

The water gas was made in the ordinary "Economical" water-gas plant, and conveyed from the relief holder to the retort-house by a special pipe. This pipe was continued over the retort-bench, just above the arch-pipes on one side, and a connection was made from it to the top of each ascension-pipe on this side of the bench. Each connection was fitted with a cock, having a lever handle with rod attached to it, so that the cock could be regulated from the charging floor. The dip-pipes on this side were blocked, and the hydraulic main valves were closed. The water gas therefore descended the ascension-pipes on this side, passed through the retorts, and up the ascension-pipes on the other side along with the coal gas.

The quantity of water gas which could be passed through each cock, when partly and when full open, was ascertained before the test by measurement through a meter. This enabled an approximate measurement of the quantity of water gas put into each retort to be made; but the actual quantity used in each experiment was checked by noting the quantity taken out of the holder. The heat of the retorts was, throughout the tests, maintained as nearly uniform as possible, and at as high a temperature as is used in ordinary working.

I was under the impression that with a double-ended retort of the kind we were using, such slight differences in the depth of seal of the dip-pipe as were likely to occur would probably result in the largest proportion of gas escaping by the end at which the seal was lightest; so that I imagined that no difficulties would arise from the closing of one of the ascension-pipes. But to make sure of this point, a series of trials were made with the coal carbonized alone under these conditions, when it was found that the normal make of 10,466 cubic feet per ton was reduced to 8615 cubic feet; and the illuminating power rose from 15·88 to 18·58 candles giving, in candle-feet, $\frac{8615 \times 18{\cdot}58}{5}$ = 32,013.* That this was not due to lowering of temperature, was shown by continuing the experiment with the previously closed ascension-pipe open, when normal results were at once obtained. This result, however, made one feel that the figures obtained when the water gas came to be used would have to be taken with some reservation, as it was manifest that the normal conditions of working were not being fulfilled.

From the end of July till the end of August, the experiments were carried on continuously, in order to ascertain the best period at which to introduce the water gas, the most advantageous rate of flow to employ, and the percentage of water gas to coal gas that gave the most economical results; and during these experiments many points of interest cropped up, and the usual small difficulties presented themselves and had to be overcome.

A question which had to be settled at a very early stage in the experiments was the method by which the illuminating power of the mixed gases was to be determined. The "London" argand, as the standard burner for all gases of less illuminating power than 21 candles, was, of course, employed; but it is perfectly well known that for gases below 15-candle power a grave injustice is done to the gas, when consumed at the 5 cubic feet rate of flow, especially when the reduction in candle power is brought about by an admixture of hydrogen or water gas with the coal gas, as when these are present in any large quantity, the size of flame given by the gas passing at the rate of 5 cubic feet per hour is so reduced that serious loss of light takes place.

The "London" argand is a beautifully constructed scientific burner devised to supply the right amount of air to ensure the proper combustion of a gas-flame 3 inches in height. Directly the flame is materially longer or shorter than this, the conditions of combustion are altered. But by burning the gases at such a rate of flow as will yield a 3-inch flame, taking the candle power, and then calculating to a 5 cubic feet rate of flow, accurate results can be obtained for gases having any candle power between 10 and 30 candles; and it was this method of testing that I should have preferred from a scientific point of view.

Mr. Shoubridge, however, very properly objected that this was not the process that would be adopted in testing his gas as it would be sent out, and that as it was the commercial value of the process that was in question, the right course to adopt would manifestly be to use the Referees' table photometer under all the conditions laid down in their instructions for the testing of the gas; and all the illuminating values given in the paper have been determined in this way.

In using water gas in the way proposed, it was soon found that the addition of small percentages gave but little gain; but that with an increase in the quantity of water gas used, the gain in candle-feet became more and more marked, as is shown in the following table:—

Water Gas Added per Cent. of Coal Gas.	Candle-Feet per Ton of Coal.	Percentage Gain per Ton of Coal in Candle-Feet.
28·8	35,147	5·5
35·2	36,231	8·8
41·1	40,833	22·6
55 7	40,331	21·1

So it was evident that the maximum gain in candle-feet, as compared with the 33,246 candle-feet given by the coal under ordinary conditions, was obtained when from 40 to 50 cubic feet of water gas were used for each 100 cubic feet of coal gas.

Another point, however, that has to be considered by the gas manager is the percentage of carbon monoxide present in the gas; and I am strongly of opinion that this should not exceed 15 to 16 per cent.—a quantity which, according to the analyses made during the experiments, would limit the use of blue water gas to about 40 per cent. of the coal gas.

Taking the experiment nearest to this figure, the full data are given on next page.

* Professor Lewes remarked here that these were most extraordinary results; and, replying to Mr. Livesey, he said he repeated the experiments three times.

Date of Experiment, Aug. 27 and 28, 1900.

Coal carbonized	82 tons
Make of gas per ton	13,730 cubic feet
Water gas added per ton	4,005 ,, ,,
Percentage water gas added	41·1 per cent.
,, ,, ,, in mixture	29·1 ,, ,,
Candle power	14·87 candles
Candle-feet, $\frac{13,730 \times 14·87}{5}$	40,833 ,,
Gain in candle-feet on standard (33,299)	22·6 per cent.

Analysis of Gas.

	I.		II.
Hydrogen	50·37	..	50·62
Saturated hydrocarbons	29·24	..	29·49
Unsaturated hydrocarbons	2·98	..	2·48
Carbon dioxide	0·49	..	0·49
Carbon monoxide	14·92	..	14·92
Oxygen	nil	..	nil
Nitrogen	2·00	..	2·00
	100·00	..	100·00

Calorific Value.

Calories	149·8 gross	..	132·9 net
B.T.U.	599·2 ,,	..	531·6 ,,

If the candle power obtained by using a 3-inch (16·78 candles) flame had been taken, the gain would thus have been 29·2 per cent.

The end of August means to the gas manager the end of all leisure for the year, and the experiments had for the time to be abandoned; while, in view of the doubts raised by the abnormal behaviour of the coal when carbonized alone in the retorts with one ascension-pipe closed, it was felt that, promising as the results were, it would be better not to publish them until a more satisfactory comparison could be made. The opportunity to do this occurred this summer, when Mr. Shoubridge, having erected a new bench of 70 inclined retorts, decided to again try the effect of water gas on carbonization.

The water gas was made, as in the previous experiments, in the generator of the "Economical" plant usually employed for the manufacture of carburetted water gas. The gas was passed into a holder of 469,800 cubic feet capacity, and was thence carried to the inclined retorts, into which it entered at atmospheric temperature. The gas was not purified before being admitted to the retorts, but was tested for carbon dioxide, of which it contained from 5 to 6 per cent. The carbon dioxide (after estimation) was deduced by calculation from the volume of water gas used, because the volume of mixed gas produced was measured in the station meters after the whole of the carbon dioxide had been removed by purification in the usual manner.

To ascertain whether the carbon dioxide in the water gas was converted into carbon monoxide by passage through the retorts, the mixed gas was examined at the inlet to the washers and found to contain 3 per cent. of carbon dioxide. It may therefore be assumed that the carbon dioxide as it passed through the retorts was not to any appreciable extent converted into carbon monoxide.

No station meter could be placed at my disposal for the measurement of the water gas. The holder of known capacity (469,800 cubic feet) was therefore filled before the commencement of each experiment; no gas being admitted to the holder during any trial. The volume of the gas was obtained by recording the height of the holder at the commencement and completion of the experiment, and making all the necessary corrections for temperature and pressure. The quantity of water gas used during twenty-four hours varied in the different experiments from 200,000 to 370,000 cubic feet. The gas leaving the retorts was purified in the usual manner, and then passed through station meters, from which readings were made every hour.

During every hour the gas was slowly bye-passed into a small holder, from which gas was drawn at the end of each hour so as to determine the illuminating power by means of the Referees' table photometer, and from which once a day gas was drawn for analysis, and for the determination of its calorific power by a Junkers calorimeter.

The coal used in the experiments was the same kind of Derbyshire coal as had been used in the previous tests, but of slightly inferior quality. Before commencing the experiments with water gas, a trial run was made for seven days with the coal alone; the tests being made every hour, day and night, so as to obtain a standard for comparison. The principal results obtained were—

Seven Days' Trial with Coal Alone.

Total coal carbonized	603 tons
Total gas made, corrected	5,973,682 cubic feet
Make per ton	9,907 ,,
Average ill. power (table photometer)	16·55 candles
Total tar (hydraulic)	5,060 gallons
Tar per ton	8·3 ,,
Calorific power (gross)	152·6 calories per c. ft.
,, ,, (net)	138·8 ,, ,,

These figures give the value of 32,792 candle-feet per ton for the coal; and this figure is taken as the standard in the following experiments.

In arranging the apparatus for the experiments, the upper mouthpiece of each retort was fitted with a pipe and stop-cock for the admission of the water gas.

These experiments were continued from June 19 up to Aug. 23, 1901, and the passage of water gas in varying proportions through the retorts was tried, and also the influence of the period of carbonization at which the flow of diluting gas was started. It was found that, although the results obtained were far better than in the experiments made with horizontal retorts, they were of the same kind, and that the gain in candle-feet per ton gradually rose with increase in the volume of water gas used, reaching a maximum with about 40 volumes of water gas per 100 volumes of coal gas, and decreasing when this point was passed.

Water Gas Added per Cent. of Coal Gas.	Candle-Feet per Ton of Coal.	Percentage Gain per Ton of Coal in Candle-Feet.
21·9	37,582	14·6
25·5	38,235	16·6
27·8	41,343	26·0
37·6	40,936	24·8
40·1	43,703	33·2
42·0	42,984	31·0
45·6	40,467	23·4

The most important data with regard to these experiments are tabulated at the end of the paper (Table I.); but the results are so extraordinary, and so full of interest, that it is as well to give the full data for the experiments in which 40 and 42 per cent. of water gas respectively were added, as it gives a better idea of the scale of the experiment.

Date of Experiment, July 9 and 10, 1901.

Coal used	85·4 tons
Total make (corrected)	1,274,656 cubic feet
Make per ton	14,925 ,,
Illuminating power (table photometer)	14 4 candles
Total tar (hydraulic)	690 gallons
Tar per ton	8·07 ,,
Water gas added	42 0 per cent.
Water gas in mixture	29·5 ,,
Water gas per ton of coal carbonized	4,415 cubic feet
Candle-feet per ton $\frac{14,925 \times 14·4}{5}$	= 42,984
Standard for coal carbonized alone	32,792
Increase in candle-feet	31·07 per cent.

Calorific Value.

Calories	127·2 gross	..	116·8 net
B. T. U.	508 8 ,,	..	467 2 ,,

Carbon monoxide present in purified gas, 14 per cent.

Date of Experiment, Aug. 22 and 23, 1901.

Coal used	88 tons
Total make (corrected)	1,294,946 cubic feet
Make per ton	14,715 ,,
Illuminating power (table photometer)	14 85 candles
Total tar (hydraulic)	651 gallons
Tar per ton	7 4 ,,
Water gas added	40 1 per cent.
Water gas in mixture	28 6 ,,
Water gas per ton of coal carbonized	4,215 cubic feet
Candle-feet per ton $\frac{14,715 \times 14 85}{5}$	= 43,703
Standard for coal carbonized alone	32,792
Increase in candle-feet	33·2 per cent.

Calorific Value.

Calories	125·8 gross	..	118·7 net
B. T. U.	503 2 ,,	..	474·6 ,,

These results make it perfectly clear that a gas manager who has been supplying a 16-candle gas can, by simply putting in blue water-gas plant and utilizing 40 per cent. of this gas in the retorting, turn out between 14,000 and 15,000 cubic feet per ton of 14·5-candle gas, without any alteration in his heats or general procedure.

It will now be well to discuss more in detail the economic bearing of the process. The economic aspect of the case is, of course, entirely dependent on the cost of the water gas,

the price at which the coal gas can be put into the holder under ordinary conditions, and whether the purification of the mixed gases costs substantially more than the coal gas would do.

I have on several occasions pointed out the wonderful advance in water-gas manufacture brought about by the Dellwik process; but, with the exception of Mr. Glover and Mr. Paterson, who went with me to some of the Continental works and verified the fact that some 70,000 cubic feet of good water gas could be made per ton of gas coke, I think most gas managers were a little sceptical as to the possibility of attaining these figures. Any doubt, however, on this point can now be put at rest without journeying abroad, as the Dellwik generator erected by Mr. Glover at West Bromwich is now at work, and I am informed turned out 74,548 cubic feet of crude water gas per ton of coke on its trial trip. So that, even with coke at a fairly high price, the cost, including all charges, should not exceed 3d. to 3½d. per 1000 cubic feet.

With regard to purification, the water gas contains no bisulphide of carbon, less sulphuretted hydrogen than the coal gas, and should only contain 4 per cent. of carbon dioxide. The water gas made in the "Economic" generator we have been using at Sydenham, however, averages 5 to 6 per cent.; and the mixed gases leaving the scrubbers contain an average of 3 per cent. So you can judge for yourselves as to the increased cost over that of purifying ordinary coal gas; and as when hot water gas is used instead of cold, most of the carbon dioxide in it is reduced to carbon monoxide in contact with the carbon in the retort, it is evident that increase in cost due to purification is a negligible quantity.

The question of the alteration in quantity and quality of the tar will with many be an important point. But it will be seen from Table II. that the decrease in quantity condensing in the hydraulic main is very small; while fractional distillation shows no alteration of character that can be with certainty identified without some further experiment. There is, however, a slight average increase in specific gravity and in ammoniacal liquor; so that, as far as can be at present ascertained, the process offers no grave disadvantages in this direction.*

An idea has in some strange way arisen that water gas when mixed with coal gas renders it less fitted for use with incandescent mantles; and the reason given for this is that the calorific value of the water gas is only some 300 B.T.U., instead of the 500 to 600 B.T.U. given by ordinary coal gas. This, however, is a total fallacy, and really only means that intelligent attention has not been paid to the air supply of the burner. With pure water gas, consumed in an argand burner, it is quite possible to develop the same amount of light from an incandescent mantle as is obtained with the same mantle on an atmospheric coal-gas burner of the usual type, consuming a mixture of coal gas and air; the reason being that, as the water gas gives a non-luminous flame, no previous admixture of air is necessary, and the gas burns where it comes in contact with the atmosphere—the whole of the heat being utilized to raise the mantle to incandescence. With the ordinary bunsen burner, however, a large proportion of the air needed for the combustion of the gas is drawn in from the holes at the bottom of the burner, and gives the inner cone of the bunsen flame, which has but little effect on the mantle. It is only the residual products of incomplete combustion that burn in actual contact with the surface of the mantle and give the chief result; while the nitrogen of the air used in the primary combustion is heated to nearly the temperature of the flame, and, escaping, takes with it a considerable proportion of the heat. So that, although the calorific value of the coal gas may be double the calorific value of the water gas, there is practically little or no difference in the temperature of the outer zones of the flames in which the mantle is heated.

With mixtures of coal gas and water gas, such as are produced by passing 40 per cent. of water gas through the retort during carbonization, it only requires a slight reduction in the size of the air holes of the burner to get the same illuminating effect from the mantles; while the chance of carbonization of the mantle is reduced to a minimum. It will also be found that the adoption of the process will do away with stopped ascension-pipes, and will reduce naphthalene troubles to a vanishing point—factors in favour of the process which the practical gas manager is sure not to underrate.

In attempting to estimate the saving in cost which the process is likely to bring about, local factors play so important a part that it is difficult to give figures which will suit in all cases; but I think a fair idea may be obtained in the following way: A 16·5-candle power coal gas in the holder costs at the present time 1s. per 1000 cubic feet, and the mixture of coal gas and water gas produced by passing 40 per cent. of water gas through the holder would cost—

1000 cubic feet of coal gas	1s. 0·0d.
400 ,, ,, water gas, at 3½d.	0 1·4
	1s. 1·4d.

So that 1400 cubic feet of 14·4-candle power gas costs 13·4d., or 1000 cubic feet will cost 9·57d.

If it is desired to send out 16·4-candle power gas, benzol enrichment will give the necessary 2 candles, at a cost of something under 0·75d.; so that the cost per 1000 cubic feet of the 16·4-candle gas would be reduced to 10·32d. in the holder. The calculation may also be made direct from the candle-feet yielded per ton of coal.

Taking round figures, a ton of coal under ordinary conditions of carbonization yields 32,792 candle-feet, at a cost of 1s. per 1000 cubic feet in the holder; and at 10,000 cubic feet per ton, this will cost 120d. When, however, 40 per cent. of water gas is passed through the retort during carbonization, the ton yields 43,703 candle-feet; and the cost will be—

10,000 cubic feet of coal gas	120d.
4,000 ,, ,, water gas	14
	134d.

If, however, the 43,703 candle-feet had been produced by carbonizing coal in the ordinary way, the cost would have been $\frac{43{,}703 \times 120}{32{,}792} = 159{\cdot}9$d.; and the economy effected would be 159·9 − 134 = 25·9d. per ton of coal carbonized.

With regard to the heating value of the mixture, it will be seen from the tables that the admixture of 40 per cent. of water gas reduces the net calorific value about 15 per cent.

The experiments, the results of which I have now brought before you, make it clear that, by adopting this method of utilizing water gas, an enormous economy may be obtained; but I am myself convinced that these results can be greatly improved upon. Instead of using cold water gas, which checks the heat in the crown of the retort, hot water gas, either direct from the generator or heated by passing through iron pipes recessed in the walls of the retorts, should be employed; while much has yet to be done in proportioning the rate of flow of the water gas to the rate of evolution of gas from the coal in the retort. And if these early experiments show so large a saving, it is not unreasonable to hope that, as the process is developed by your experience and engineering skill, even better results may follow.

I must, however, in taking leave of the subject, warn you that it is probable that much may depend on the quality of the coal; and that whereas with rich coals, shales, and cannels, the gain may run up from 30 to over 100 per cent., yet that with poor coals the results may be inferior to those I have brought before you. I, however, feel convinced that, as your investigations proceed, the possibilities of enriching water gas with illuminating hydrocarbons that are at present lost in the formation of tar, will exceed your most sanguine expectations.

In conclusion, I have to thank my assistant, Mr. H. F. Hills, for the great help he has given me, and also Mr. R. English, F.C.S., the Assistant-Engineer at the Crystal Palace District Gas-Works, for the constant attention he has given to these experiments, and the skill he has shown in overcoming those troubles which always arise when gas-making plant is put to uses other than those for which it was erected.

* Professor Lewes remarked that this was an important point. It would be found in the experiments that they were only able to deal with the tar and ammoniacal liquor in the hydraulic mains, simply because they had in the tar-well no power of separating the make from the other makes. But still what they found in the hydraulic main was a fair indication of what was going on. All the members had had before them details with regard to the Mond process; and it would be remembered that in the Mond system of gas making, a large amount of steam was blown through the fuel together with air; but, by so doing, the temperature was lowered to a point at which they had the ammonia as it was formed broken up. In this process of passing the water gas through the retort, they got with the water gas going in with the gas passing through the crown of the retort a cooling influence of the same character; and when experiments could be made on a large scale, and the various products isolated, it would be found that the increase in ammoniacal liquor was a very important one. The figures at the present time only justified him in saying that there was an increase; but it would be found that it was an important one.

TABLE I.—*Inclined Retorts*, 1901.

—	Coal Alone, Average Seven Days' Trial.	Water Gas Added ½ Hour After Charge and Continued for 3½ Hours.	Water Gas Added 1 Hour After Charge and Continued for 3 Hours.	Water Gas Added Immediately After Charge and Continued for 4 Hours.	Water Gas Added Immediately After Charge and Continued for 2½ Hours.	Water Gas Added Immediately After Charge and Continued for 3 Hours.	Water Gas Added ½ Hour After Charge and Continued for 3 Hours.	Water Gas Added Immediately After Charge and Continued for 2 Hours.
Water gas added, per cent.	..	21·9	25·5	27 8	37·6	40·1	42·0	45·6
Average illuminating power (table), candles.	16 55	14 83	14·68	14·74	15·27	14·85	14·40	13·74
Candle-feet per ton	32,792	37,582	38,235	41,343	40,936	43,703	42,984	40,467
Increase in candle-feet per ton, per cent.	..	14·6	16 6	26 0	24·8	33·2	31·0	23·4
Total make per ton, cubic feet	9,907	12,671	13,023	14,024	13,404	14,715	14,925	14,726
Tar per ton in hydraulic main, gallons	8 3	7·7	7 6	7·4	7 3	7·4	8·07	8·1
Gross heating power, calories per cubic foot	152·6	133)	128 8	129·5	126·7	125 8	127·2	126·0
Net heating power, calories per cubic foot	138·8	122 7	118 2	112·7	117 6	118·7	116·8	117·1
Carbon monoxide, per cent.	7 19	10 0	..	12 0	13 2	..	14 0	17·0
Water gas added per ton of coal carbonized, cubic feet	..	2,276	2,654	3,057	3,667	4,215	4,415	4,615

TABLE II.—*Hydraulic Main Tar (Inclined Retorts).*

—	Date. 1901.	Gallons Per Ton of Coal.	Specific Gravity at 70° Fahr.	Below 170° C.		170° — 270° C. Middle Oils Per Cent. by Vol.
				Ammoniacal Liquor Per Cent. by Vol.	Light Oils Per Cent. by Vol.	
Coal gas alone, 7 days' trial (a)	June 19-26	..	..	1·4	2·2	20 8
(b)	..	8·3	1·207	1·6	3·2	22·8
(c)	..	..	1·219	2·0	4·0	22 8
Coal gas with 42·0 per cent. water gas added	July 10	8·1	1·228	2·6	2·2	20·4
Do. ,, 21·9 ,, ,,	,, 11	7·7	1·222	2·2	3·4	22·0
Do. ,, 27·8 ,, ,,	,, 16	7·4	1·221	3·2	3 6	18·6
Do. ,, 25·5 ,, ,,	,, 18	7·6	1·225	3·4	3·0	19 6
Do. ,, 23·6 ,, ,,	,, 23	8·1	1·236	2·6	2·2	20·4
Do. ,, 37·6 ,, ,,	,, 30	7·3	1·217	3·2	1·4	20·6
Do. ,, 45·6 ,, ,,	Aug. 1	8·1	1·209	2·6	2·8	20·8

TABLE III.—*Some Typical Results, Showing that, the Lower the Illuminating Power of the Gas, the Greater the Advantage Gained by Testing with a 3-inch Flame and Correcting to 5 Cubic Feet per Hour, instead of at a 5-Cubic Feet Rate.*

Coal Gas Alone.

5 cubic feet per hour rate	14·20	14·33	16·22
16-candle flame corrected to 5 cubic feet	15·44	15·68	16·55
3-inch flame ,, ,,	16·40	16·77	17·90

Coal Gas with Water Gas.

Per cent. water gas added	28·80	35·20	41·40	55·70
5 cubic feet per hour rate	14·77	13·20	12·79	12·48
16-candle flame corrected to 5 cubic feet	15·60	15·06	14·87	15·43
3-inch flame ,, ,,	17·28	17·00	16·78	16·42

TABLE IV.—*Cost of Blue Water Gas.*

(From figures furnished by Mr. C. Dellwik.)

Yield of gas per ton of coke in generator	70,000 cubic feet.
Consumption of steam per 1000 cubic feet	52·5 lbs.
Which with water preheated, as done by the new design of Dellwik-Fleischer generator, will require at most	7·5 lbs. of fuel.
For one generator to produce 500,000 cubic feet of water gas per diem, cost of labour amounts to	8s. per shift.
For two generators to produce 1,000,000 cubic feet per diem, the cost of labour would not exceed	12s. ,, ,,

The cost of the crude gas then figures out as follows:—

(A) For a production of 500,000 cubic feet per diem—

	s.	d.
Coke for generator, 7·14 tons at 12s. 6d.	89	3
Steam fuel, 1·7 ,, ,, 5s.	8	6
Labour, 3 shifts ,, 8s.	24	0
Water, repairs, and sundries	8	3
	130	0

Cost of gas per 1000 cubic feet, 3·12d.

(B) For a production of 1,000,000 cubic feet per diem—

	s.	d.
Coke for generator, 14·28 tons at 12s. 6d.	178	6
Steam fuel, 3·4 ,, ,, 5s.	17	0
Labour, 3 shifts ,, 12s.	36	0
Water, repairs, and sundries	16	6
	248	0

Cost of gas per 1000 cubic feet, 2·98d.

Discussion.

The CHAIRMAN said this was a paper which deserved the greatest attention, and he had now to invite discussion upon it. No doubt there were many questions they would like to ask Professor Lewes, and there would be some points on which they would desire to express their views.

Mr. G. R. LOVE (Guildford) said he had listened with a great deal of interest to the paper by Professor Lewes; but there was one point he would like to have made a little clearer. Perhaps it might be that he was rather dull in the uptake, but Professor Lewes said that in working with horizontal retorts, and closing one end, if he was right in his view—closing one of the ascension-pipes and working the through retorts with only one ascension-pipe—the normal conditions went down very considerably; and then his other experiments were with inclined retorts, where he had only one ascension-pipe, and that he did not then find the decrease in volume, in the carbonization with ordinary coal, which he had found in the horizontal retorts. Did he (Mr. Love) understand this to be correct?

Professor LEWES: Perfectly.

Mr. LOVE said he had lately put up a bench with only one ascension-pipe, and he found that he had no diminution in the yield of gas per ton of coal carbonized, and he was very surprised to find the result given in the paper.

Professor LEWES: You could not have been more surprised than I was.

Mr. LOVE said his retorts were horizontals, and he got from 10,000 to 11,000 cubic feet of gas per ton of coal carbonized, with a single ascension-pipe.

Mr. G. H. MILLARD (Durham) said he should like to ask Professor Lewes whether his mixed gas with 40 per cent. of blue water gas was distributed straight out into the town, as, from his little experience in distributing a mixture of coal and water gas in anything like that proportion, such gas would cause considerable trouble to the consumers, not only in the lighting burners, but in other ways.

The CHAIRMAN remarked that he might say that it was a very small proportion of the total make, and it could not be distributed as it was.

Mr. MILLARD said the point he wished to make was that 40 per cent. could not be regularly distributed, on account of the effects, not only on incandescent burners, but also on gas fires and cookers. There would be a danger of firing-back.

The CHAIRMAN: Well, if there is, don't; but there are certain gas companies which I could name distributing more than 40 per cent.

Mr. MILLARD said that another point he wished to refer to was as to hot water gas being passed through the retorts. A considerable difficulty which he saw was in the fact that if they wished to keep a record of the proportion of the water gas and of the coal gas, and they put in hot water gas as generated, they had no check on the two.

Mr. W. GRAFTON (London) asked to be allowed to refer to the question of the illuminating power and the method of arriving at it. According to the paper, it was arrived at by the Gas Referees method. But this was not quite as would be the case if the actual quality of 14 candles were distributed; and so a higher result had been obtained in these cases by about ¾ candle, owing to the effect of the argand on the quality. He thought, therefore, a little of the flower of the paper might disappear by testing the gas on a 14-candle basis. The quantity of air admitted to the argand was the governor of all results obtained by it; and so the larger

flame of 16-candle value gave the gas an additional advantage as stated.

Mr. T. GLOVER said his name had been mentioned in the paper as having used at West Bromwich the Dellwik process of making water gas, and the mixing of the water gas in the foul main; and it might be interesting to the meeting to know the result of their working. From the figures obtained from the Continent, he was given to understand that the amount of benzol required for the enrichment of the mixed gases, when using 20 per cent. of blue water gas mixed with the coal gas in the foul main, would be half-a-gallon. He was very pleased to say that the results of his working had shown this to be practically correct. There was not a proportionate decrease in the illuminating power when the gases were mixed in the foul main, from what they could arrive at by calculation, owing to the blue water gas picking up in the foul main a considerable amount of hydrocarbon matter; and it was exceedingly simple to enrich the mixed gas by means of benzol, which was now obtainable at about 10d. per gallon. If they allowed (say) 4d. or 4½d. per 1000 cubic feet—he thought 4d. would be the correct figure—for purifying blue water gas, and added to it the cost of half-a-gallon of benzol, they got the finished water gas at 9d., which was a remarkable figure, when they remembered that, with the ordinary method of making carburetted water gas, they used 2½ gallons of oil to begin with; and then there were other charges.

The CHAIRMAN: Does benzol carry, when mixed in that way?

Mr. GLOVER said their gas was tested against them in the town, and it was found to be all right. He had had no trouble so far. He ought to say, perhaps, that it had not yet been through any very severe weather, and he could not speak as to that. But as the illuminating power of the coal gas depended almost entirely upon benzol, to begin with, and they knew that it was capable of carrying a great deal more than it had naturally in it, they could afford to put in a little more; and the water gas itself would carry some benzol. He ought to mention that the coal gas figures at West Bromwich, where these results were obtained, were exceptionally high, and that therefore the increase in the sperm value was not due to very poor results in the coal gas making; because they got more than 11,000 cubic feet of gas per ton of coal throughout the year, and the illuminating power of the gas obtained from the coal, before enrichment, was from 15 to 15⅛ candles. He had not been able to carry out the experiments on the same scale, or in the same way, as Professor Lewes had given them in his paper; but he could follow his description, which was very interesting indeed. He thought they must all acknowledge that it was quite possible to secure the results that he had obtained—he should not say on a small scale, because the carbonizing of 100 tons of coal as an experiment might be regarded as being on a fairly large scale. Certainly, they were very exceedingly obliged to Professor Lewes for these results.

Mr. W. R. HERRING (Edinburgh) said that, broadly speaking, he thought the issue before them was the possibility of increasing their carbonizing by about 40 per cent., without adding to their retort-house plant, and without burning any more coal, by simply using up a small percentage of their residual coke. Of course, it was impossible for him to criticize the figures Professor Lewes had given them, which he had obtained by his large-scale experiments. These, he thought, must be accepted for the time being as facts, which, no doubt, were most correctly taken and ascertained when working on a fair scale. What he wished to point out was the necessity of experiments with this process elsewhere, and with other coals. He had no doubt that they in Edinburgh would obtain probably much better results. Certainly they would expect to do so, seeing the high-class coal they used. He might say that Professor Lewes's ideas struck him so forcibly at the 1900 meeting of the Institution, that he rigged up two settings of inclined retorts, with the necessary pipes and apparatus—meters and everything else—but he was sorry that he had not had the time to carry out the experiments he intended. If, however, Professor Lewes would send up his assistant (say) next spring, he would be very glad indeed to place the apparatus at his disposal, so that they might have records taken of the results obtained from a great number of classes of coal.

Mr. CHARLES HUNT (Birmingham) was sure they were all impressed with the very great importance of the subject before them, and must acknowledge their indebtedness to Professor Lewes, to Mr. Shoubridge, and to all concerned. for having carried out these experiments and given them the benefit. The desirability of a cheap method of reducing illuminating power must be obvious at the present time; and here they had a process which promised them very great advantages. He agreed, however, that it was most desirable, before absolutely accepting the process as one capable of universal adoption, that further experiments should be made with different sorts of coals. And the results did appear to be somewhat contradictory; or, at any rate, the method of testing the gases did not absolutely make it clear to his mind that something was not due to the method of testing, rather than to the results obtained. Again, the tar appeared to show no falling off, either in quantity or quality. If not, from whence was the advantage derived? He also was struck, in the same way as a previous speaker, with the earlier results; and he should like to ask Professor Lewes whether any analyses were made of the gases, in both cases—the ordinary gas and the gas when one ascension-pipe was stopped. He presumed that the result was due really to the one ascension-pipe not being sufficient for the large volume of gas coming from the retorts, augmented by the 30 or 40 per cent. of water gas.

Professor LEWES: It was without the water gas.

Mr. HUNT said then that reason did not apply. Would Professor Lewes kindly say what was the illuminating power, in each case, of the gases named in the four tabulated experiments by Mr. Shoubridge? The candle-feet per ton was given, but not the actual illuminating power.

Professor LEWES: That you can get from Table I. at the end of the paper.

Mr. HUNT: Yes; I see it. Then the coal alone gave 16·55 candles, and the water-gas mixtures gave a varying result from 15·27 to 13·74 candles; so that the normal difference was about a candle.

Professor LEWES: A candle and a candle-and-a-half.

Mr. HUNT: And they were in all cases tested according to the instructions of the Gas Referees?

Professor LEWES: Yes.

The CHAIRMAN: As the experiments were carried out at Mr. Shoubridge's works, I think the meeting would like to hear him on the subject.

Mr. S. Y. SHOUBRIDGE (Sydenham) said he did not know that he could add anything to Professor Lewes's very able paper; he would not attempt to "refine gold" in that way. But he would like to say what great pleasure it gave him to co-operate with Professor Lewes in this very interesting set of experiments; and he could assure the members that they were all most carefully carried out. The tests were made hourly throughout the twenty-four hours, by Professor Lewes's assistant and his own; and everything was weighed and measured with the greatest possible exactitude, so that they could rely absolutely upon the accuracy of the figures which had been given. He wanted to disclaim any sort of credit for the results that had been obtained. Professor Lewes was the originator of the idea; and he had put them all, he was sure, as an industry, under a deep obligation to him for showing them the way in which a cheaper gas could be made—and not only that, but he gave all the particulars necessary for the conduct of the experiments. Professor Lewes played the tune, and he blew the bellows, so to speak. But the experiments were unfortunately not so conclusive as one would like them to be, owing to the difficulty of continuing them long enough without interfering with the ordinary operations of the works. One would have wished, instead of having experiments of twenty-four hours' duration, to have had them from week to week under each kind. The results would, he thought, then have been better and more reliable than they were under the shorter length of experiments. But they would all agree that the experiments had gone far enough to induce many of them to continue, and to improve upon them.

Mr. J. W. HELPS (Croydon) said that, as one who had had an opportunity of seeing the conditions under which the experiments had been carried out, he should like to bear testimony to the very careful and painstaking way in which all the tests were made. There was just one point in the paper which he should like to mention. Professor Lewes spoke of the amount of carbonic acid in the water gas increasing in the mixed gas, so that it issued into the purifiers containing about 3 per cent.; and he dismissed it rather airily, and stated that it would not interfere in any way with the purification. As one who had had some difficulty with sulphur compounds, and having as they had the rotation

system, he could not help thinking that a gas containing 3 per cent. of carbonic acid going into the purifiers would adversely influence the conditions under which the purification would be carried out.

The CHAIRMAN said he thought the time had come to call upon Professor Lewes to reply to the questions which had been put. It was not for him, as Chairman, to discuss the paper, because time would not allow of it; but it seemed to him that the point Professor Lewes had brought before them was the essential point they should have to consider in the immediate future—how to cheapen gas, and at the same time lower the illuminating power without seriously diminishing the heating value. And as a step in this direction—as an indication of how they might begin that great work which lay before them—he regarded the paper as invaluable.

Professor LEWES said that, taking the objections, or the remarks rather, as they were raised, Mr. Love pointed out his surprise at the results obtained when one of the ascension-pipes was closed. As he told them at the time, Mr. Love's surprise was not at all greater than his own, when it occurred; it was entirely in opposition to all one's preconceived ideas. It could only mean that they had a gas, as it came from the coal, having a longer travel through the heated retort, and he should have expected a greater degradation of the gas, with an increase in volume, and with an increase probably of naphthalene. Here, however, they had distinctly a falling off in the quantity of gas; and a trial was made three or four times, to see if the results came out the same. In each case they got precisely the same results. They then opened the other ascension-pipe, so as to work the two ascension-pipes again; and they went back to exactly the original figures once more. So it was not chance, due to leakage or troubles of that character; it was something going on in the retort itself. Analyses were made of the gas under normal and abnormal conditions; and he was at present trying to find out, by chemical means, what it actually was that was taking place—what it was in the action of the heat of the hydrocarbons which gave rise to that effect. As soon as he could give the information, the members should have it.

Mr. LOVE: Was there any difference in the seal or in the tar in the hydraulic main?

Professor LEWES said he had not yet the necessary information at his disposal to give an answer to that. He had samples of tar that were taken; but these samples had not been touched yet—they had been standing in his laboratory sealed up for over a year. They tried several experiments, however, at the same time. They filled up the far end of the retort with inert matter, so as to have only half the retort doing its work; and they found a distinct improvement in the yield of gas, but a lower illuminating power. They tried to find out what was happening; but the only point that was really concordant was that the candle-feet remained almost perfectly constant. They had the make; and multiplying by the illuminating power, the candle-feet remained almost a constant throughout the experiment. As he pointed out in the paper, so careful had they been that no misconception should arise upon points of this character, that nothing was said about the experiments until they could be confirmed by some further tests in sloping retorts. Mr. Millard asked about the distribution of the gas, as he feared the 40 per cent. of blue water gas present would interfere with the operation of gas-burners, and also with the burning of gas-fires and gas cooking-stoves. Now, as their Chairman had said, the quantity of gas that was being made, although it amounted to over a million or so, was a small proportion of the total make of the works. This gas was simply mixed in with the ordinary make, and was passed out; and no trouble was experienced in any part of the district. Although 40 per cent. of water gas was added, there was not 40 per cent. of water gas in the gas. If they took 100 volumes of coal gas, and passed in 40 volumes of water gas, this made 140 volumes; but if they took 100 volumes of the mixture, the 100 volumes would only contain (say) 29 per cent. of water gas. This was a quantity with which many, or most, of the consumers' burners could deal. It was only a question of making the holes of atmospheric burners in stoves, or those used for incandescent mantles, slightly smaller, to do away with any troubles on that point. The trouble which Mr. Millard also pointed out, of using hot water gas, was, of course, absolutely so. In making experiments, as they must measure with the greatest care the water gas used, they must have the water gas cold, and in a condition in which they could measure t. But he conceived, when they had all their data with regard to the effect of using the cold water gas, they would then be in a position to know practically what volumes could be employed; and by regulating the inlet of the gas to the retorts, they would be able to use the gas direct from the generator. And in this slightly heated condition, he thought they would find the carbon dioxide (4 or 5 per cent.) would be reduced by contact with the hot carbonaceous matter and hot hydrocarbons in the retorts themselves. These were the reasons why he skimmed rather lightly over the extra 1 per cent. of carbon dioxide which at present the experiments appeared to put into the coal gas. Mr. Helps owned up to having 2 per cent. in his crude coal gas; and if he used cold water gas through his retorts, he would get 3 per cent. This would undoubtedly necessitate the alteration in the rotation; and when they came to finally work it, this trouble would largely disappear. Mr. Grafton raised an important point indeed, when he spoke about the standard of illumination, and the way in which the tests were made. He (Professor Lewes) had pointed out that, in order to get the candle power of the gas, they must burn the gas in such a way as to do justice to the flame. Take an ordinary "London" argand burner. If they used this at a 5 cubic feet rate of flow, the Gas Referees, and everybody connected with gas testing, had amply testified to the fact that the standard burner was not fitted for that, unless used in particular ways. Now with 16-candle coal gas, they had, when burning coal gas alone, the burner giving its normal results—when passing gas through it at the 5 cubic feet rate, they got a 3-inch flame. It was to a 3-inch flame they must burn if scientific results were wanted. The truth of this was borne out with a long range of poor gas. With rich oil gases, they could get a perfectly satisfactory value from them when burning to a 3-inch flame. Directly they began to burn with a 5 cubic feet rate of flow, using the "London" argand for a standard, if the gas which it was intended to test was a very slight fraction of a point on either side, then the "London" argand burner—with the 5 cubic feet rate of flow—would give a very poor idea of the value. If the gas was below 15½ or above 16½ candles, it would be found that they were not doing justice to the flame. It was in order to get over this trouble that the idea of testing with a 3-inch flame was abandoned; but they would have got tremendously higher results if they had used a 3-inch flame throughout. They therefore took the Gas Referees' instructions as they stood. A table photometer was used; and the gas was burnt until they got a flame which gave 16 candles of light. They then took the rate of flow, and calculated back to a 5 cubic feet rate. At the same time they took, as a precaution, tests in the ordinary way—using simply the 5 cubic feet rate of flow and the bar photometer; and though some proportion of the benefit had disappeared under certain conditions, it had by no means disappeared, as Mr. Grafton said it had. Using a 5 cubic feet rate of flow, there was only a loss of something like 25 per cent. Mr. Herring had made a most generous offer, and an offer which he (Professor Lewes) accepted. Mr. Herring should have one of his best assistants at his works clamouring for employment as soon as he knew the appearance of spring would allow him to take up the experiments. With Mr. Herring, he felt so strongly the importance of these experiments, that he should like to try them with every class of coal. He (Professor Lewes) would be only too glad to give every assistance in his power to any gas manager who liked to try the process, and see how it answered. (Applause). He would himself give any details he could; and he would do anything he could in the way of working the experiments out. By working in this way, they might obtain data which would be of the greatest possible value to the gas industry. He had to thank the members of the Section heartily for their kind attention, and for the way they had received his paper.

Liquid Fuel.—A correspondent of "The Times" calls attention to a new system of burning liquid fuel which has been recently shown in operation at the electrical works of Messrs. Muirhead and Co., of Elmer's End. The firm have installed the system for generating steam to drive their shop engines; and they say the results fully satisfy them. The chief feature in the system is the burner, or feeding apparatus, through which the fuel is injected into the furnace. The installation, burning water-gas tar, generates steam in a water-tube boiler without the slightest appearance of smoke—a fact much appreciated by Messrs. Muirhead, who more than once got into trouble through smoke when burning coal in the same boiler. By figures extracted from their accounts, the saving in the co of fuel is more than 50 per cent.

DESTRUCTION OF GAS-PIPES BY MEANS OF ELECTRICITY.

By Dr. W. Leybold, of Hamburg.

[A Paper read before the Gas Section of the Engineering Congress at Glasgow.]

As is well known, for the distribution of gas in towns, it is usual to lay long lengths of iron pipes, the larger of cast, and the smaller of wrought iron. The durability of these pipes varies from about 25 to 50 years—those of cast iron lasting longer than those of wrought. In a few cases, a quicker destruction takes place; for instance, when the pipes are embedded in cinders or ashes. Pipes are also soon corroded in gas-works, where they are frequently laid in spent gas lime or spent oxide of iron; the constant formation of sulphate of iron as well as sulphuric acid most certainly producing a dissolving effect. Formerly it was customary in small gas-works to allow the gas liquor to run into the ground; and this also caused corrosion. The pipes were formerly, and are now, principally coated with hot tar before being laid in the ground. Lately, several works, including those at Hamburg, have commenced to cover all wrought-iron pipes with canvas and boiled tar, in order to protect them from outside destructive influences.

In more recent years, a new, and previously unthought-of, enemy of our gas-pipes has showed itself—viz., electrolysis. Electric tram-lines have been constructed, and through these a strong electric current is carried both above and below the surface of the ground. In most cases (at least so far as Germany is concerned), the construction of these tram-lines is so arranged that an electric current, from one or more stations, of about 500 volts passes into the wires lying above the surface leading to the trams, and after running into the motor lying below the trams, returns, by means of the rails, to the engines at the electricity works. In order to cause the easier return transmission, the single rails are jointed at the points they meet, by thick copper wires soldered to them. As the rails give a certain resistance to the current used, it is evident that part of the current on a favourable opportunity—*i.e.*, at a short distance—will pass through the earth into the gas and water pipes.

This happens in such a way that the current from the places far distant from the electricity works goes from the rails into the pipes; whereas near the same works, the current which has gone into the earth returns to the rails, and the part remaining in the rails returns to the engines, giving the current by the return transmission wire. As the pipes yield a less resistance to the current than the earth, a larger proportion of the current passes through the pipes than into the earth itself. The current flows from the rails into the pipes in the districts further away from the electricity works, and in the vicinity of the works again flows from the pipes into the rails; the pipes in this case proving to be the positive pole. The difference of tension between the pipe and the rail in various districts can be easily ascertained. It was advisable to determine whether, in pipes in the vicinity of which there were no electric trams, an electric current was in existence.

Dr. Bunte sent his assistant, Herr Lubberger, to investigate such a water-pipe on the tableland Plinz, near Karlsruhe. This tableland lies 140 metres higher than Karlsruhe; and is 6 kilometres distant from the nearest electric station at Durlach. The system of water-pipes is certainly not influenced from the outside; and yet considerable tension was found. Also, during the time when the electric trams were not running at night at Karlsruhe, tension was observed in the gas-pipes. Electric current flows in the pipes, and that pretty constantly.

The existence of the current at points which could not possibly be influenced by the electric current, can only be traced to the fact that the pipes are made of cast and wrought iron, and that lead is used as a jointing material, which metals, lying under damp ground, produce a galvanic action. When early in the morning the traffic of the trams commences at Karlsruhe on one line only, it sends the tension through the whole length of pipes to the most distant parts. When the tram-line is in full working, there is everywhere a tension difference. In Hamburg it amounts to scarcely anything in some places, but generally about 0·2 to 1 volt, and near the electricity works even as much as 4·65 volts. It must be borne in mind that at that time the Hamburg trams were only supplied from one electric works in Carolinen Strasse, so that the current in the rails must always return there. It may be seen from the yearly report for 1900, that the electric working line was about 100 km. long, and that about 400 cars were in use. The annual consumption of current amounted to 13 million kilowatt-hours. The gas-works own a line of main pipes of 526 km. in length and 50 to 1100 mm. diameter, with 443 km. of service-pipes for houses. The experiments were extended over the whole town; and, as already stated, some tension was found at almost every point.

Now it is known that by the electric current, in the presence of saline solutions of different kinds, metals can easily be dissolved. Chloride of sodium is completely split up; and this is easily seen when two iron plates are placed in a solution of chloride of sodium, and a current allowed to pass through them. In the negative pole, development of hydrogen at once takes place; while the fluid rapidly becomes thick through the separation of green protoxide of iron. Chloride of sodium is split up by the electric current into chlorine and sodium, which latter forms with water sodium hydroxide and hydrogen. The chlorine runs to the positive pole, and forms there protochloride of iron. This is precipitated by the sodium hydroxide as mentioned, as protoxide of iron. The process thus goes on until the positive pole is completely dissolved.

The process is easily shown if a current of electricity is passed through a thick glass pipe, closed at both ends by sheet-iron plates, and filled with sand soaked in a solution of chloride of sodium. The sand at the positive pole becomes of a green colour as it sucks up the protoxide of iron which is formed. By degrees a yellow rust is produced, through admission of air. The same effect is caused by a solution of chloride of ammonia, gypsum, and carbonate of lime, in such organic salts as are always found in the earth, and also of a watery solution of earth.

The ground in Hamburg contains small quantities of chloride of sodium to the extent of 0·006 to 0·04 per cent. It is also known that the electric tramway authorities in winter time melt up the snow and ice on the rails with raw salt or refuse of refined nitrate of soda. Soft ground is saturated with the solution; whereas from asphalt or granite pavement it flows off to the sewers. Accordingly, an opportunity is afforded for the eating up of iron in the earth in the presence of a solution of salt and an electric current. American newspapers have from time to time mentioned this matter; but in Germany nothing of the kind had been noticed until a few years ago. In Hamburg, the first electric tramway (called the Ringbahn) was constructed in 1894; and gradually all the tramways were converted into electric trams—the whole work being completed by about the end of 1899.

In April, 1899, close to the electricity works in the Carolinen Strasse, an escape of gas was found. On one side of the street is the main gas-pipe, of cast iron. Wrought-iron service-pipes cross the road to the lamps on the other side. In the middle of the road there are two lines of tramway rails—cars passing at intervals of 3 minutes; so that about every 1½ minutes a tram passes any particular spot. The rails are placed upon a bed of concrete 0·2 metre thick. The gas-pipes are laid at right angles to the rails, at a depth of from 0·55 to 1 m. The street is paved with granite setts jointed with asphalt. Upon investigating the cause of the gas escape, a hole was found in a wrought-iron pipe under the first rail; and after further investigating the matter, a complete puncture was discovered under every rail. The pipe was taken out of the ground, and the four holes coincided exactly with the position of the rails. Upon closer examination, it was found that nearly all the pipes in this street were damaged in a similar way.

Owing to the holes fitting in exactly with the position of the rails, it was clear that an electric influence was the cause. A melting of the pipes, as was often found in the case of the transmission of a strong current into gas-pipes in houses, had evidently not taken place.

These 1-inch pipes are covered with canvas soaked in boiled tar. The investigation in the laboratory gave the following result: In some places the tar as well as the canvas had fallen off, and the pipes were eaten through in parts to the extent of 1 centimetre. Removing the covering, it was found that the corrosion existed in every stage from the beginning until the complete penetration. Curiously enough, the destruction was principally of spiral formation, and coincided with the wrapping of the canvas,

where between the strips of the canvas a portion of tar had been pressed out.

In many places there were blisters between the iron and the tar, which were filled up with a green solution of protochloride of iron; in some places also with crystals of the same salt. From such a blister 0·032 grain of crystalized protochloride of iron was taken out, the fluid (about 1 cubic centimetre) contained 0·0604 grain of protochloride of iron, 0·0086 grain of chloride of sodium, 0·0095 grain of chloride of ammonia, and 0·0037 grain of free hydrochloric acid. The solution was very acid, and a strong destruction of the iron was visible.

At other places there were also found blisters concealed by the layers of tar, which were filled with a green, slimy mass of protoxide of iron, of which it contained about 0·2 grain. Here also the decay was strongly visible. In other parts, the iron was completely eaten through, and covered with a thick layer of rust; the tar as well as the canvas at these places having become soft and brittle. The rust of the iron was very considerable, and contained acid, besides oxide of iron, about 9½ per cent. of protochloride of iron and chloride of iron; also 0·8 per cent. of sulphate of iron. Only 0·12 per cent. of chloride of sodium was found.

The collection of these chlorides of salts in one place is very strange. They were derived without doubt from common salt. Therefore, where a particle of a solution of salt can penetrate the tar that covers the iron, the destruction commences, and, as previously stated, in one of two ways, either into protochloride of iron or protoxide of iron—apparently as the formed hydrate of sodium gets to the spot in question, and replaces the dissolved iron, or not.

Examined samples of the earth taken from the vicinity of the pipes consisted of clayish sand containing 0·006 to 0·04 per cent. of chloride of sodium, and in other parts 0·007 and 0·012 per cent. Apparently the wrapping with boiled tar and canvas favours the destruction; for in the blisters under the tar it quietly goes on, while with a direct bedding of the pipes into the earth without any covering, the earth would have absorbed the fluid.

All the gas-pipes in the Carolinen Strasse were taken up and replaced by others all covered; but after the expiration of seven or eight months, the destruction showed itself to have taken place again in the same manner as before—the pipes being penetrated with holes.

New trials were then made with pipes simply covered and tarred, also with untarred pipes, and others protected by being placed inside a second one. After two years—during which time the electricity works had taken some measures to prevent damage—the covered pipes showed signs of destruction, also the outer pipe; while the one inside it remained intact. The plain tarred, and also the untarred pipes, were fairly well preserved though heavily covered with rust; but it could not be decided whether to a greater extent than in other streets. In exposing same to the air, the rust covering of about 2 mm. fell off. Besides this, the pipes were covered all round with a firm layer of sand.

The quantity of common salt and soluble salts of iron in the rust was in this case very small. One pipe covered partly with 5 mm. of copper wire was laid down. The same after two years had turned into a green mass, consisting of carbonate of copper and hydrate of copper, besides chloride of copper, and 0·7 per cent. of chloride of sodium. It appears doubtful whether the packing protects the pipes; but, anyhow, at every bending of the covered pipes, the covering was destroyed by the falling off of the tar. Meanwhile, other pipes of different kinds, covered and uncovered, were placed in particularly dangerous spots.

Every endeavour must be made to reduce the currents passing into the pipes; and when laying down electric tramways, great care must be taken to prevent the current flowing into the earth. This can be done in one way by the laying of well-conducted rails; the rails having sufficient transverse section, and the points of contact well joined together by soldered copper wire. The welding of the points of contact (according to the system of Dr. Goldschmidt, of Essen), by means of thermite, will probably be of great service.* A further method—and this should certainly be done in Hamburg—is by the fixing of insulated return transmission cables in many places, in order to direct the current back from the rails to the electricity works, and thus to disburden the rails. These cables should be distributed in such a manner that the tension in the rails becomes sufficiently small. Only where small tramways come into consideration can such cables be dispensed with.

With the quick development of the electric tram traffic in Hamburg, the engines were in the beginning connected with the rails in the vicinity of the works by plain copper wires; and it was remarked that, even under these wires, the gas-pipes showed signs of decay. Formerly the current for the trams was supplied from one works only. During last year a second one was opened at Barmbeck; and shortly a third one at Hammerbrook will be opened, in order to assist the others. The supply will then be divided among the three works; and the tension at each place will be lessened.

The electricity authorities were persuaded to place a large number of insulated return transmissions similar to the feeding cables of the trams; and in consequence of this measure, the destruction of gas-pipes caused by the current escaping from the rails can in future be left quite out of the question. While formerly in the Carolinen Strasse tensions between rails and gas-pipes occurred up to 5 volts, these have now been lessened to 0·45 volt maximum. Also in the whole system of the town, a pretty uniform and very small tension is observable, which in some cases is nought, and even has a tendency on the other side.

The whole affair has cost a great deal of money to the electricity works; but the measures taken have proved to be necessary in order to avoid the threatened danger to all the gas and water pipes. It has to be remarked that in cast-iron pipes no such destruction has so far been perceptible—the pipes of the water-works, which generally are lying deeper than those of the gas-works, showed no signs of decay, with the exception of some lead pipes in the vicinity of the rails.

Not long since, at Erfurt, similar damages appeared. Upon the commencement of the running of the electric trams, the old rails of the tramway were kept in use. They were not suitable, however, for the heavy electric tram; the consequence was that the connection of the rails became bad, owing to the proportionately heavy bending at the points where the rails meet each other. They gradually became looser and looser; and this, in conjunction with the very small transverse section, caused great electrical resistance in the current. This circumstance is no doubt the cause which led to the finding of the electrical destruction of the pipes at Erfurt.

Recently the German Electrical Technical Association has been busy with the drawing up of directions for the protection of gas and water pipes; and they prepared a statement of precautions, of which particulars will shortly be published. In the report, the requisite directions will be given for construction and arrangements; so that escaping currents may be reduced to a minimum. At any rate, the gas and water works can demand that the electricity authorities shall do everything in their power to protect their pipes. It may be remarked that electric currents in dwelling houses are suspected of having caused much destruction of imbedded pipes within the walls, whereby the electric wires must have a connection with the earth. Such an example has been recently found.

It is well known that among different metals currents circulate in a solution of salt, as, for example, in a gas-meter, the drum of which consists of Britannia metal, and the outer casing of lead-covered iron plate; whereas the filling is chiefly salty glycerine, chloride of lime, chloride of magnesia, or water. The water of Hamburg is filtered water from the River Elbe; one litre containing 0·25 grain of salt. Even this is sufficient to produce a current. This may be to a certain extent the cause of the gas-meter drums being destroyed. A slight current also circulates in the station governor of a gas-works, between the outside tank and the governor bell; the tank consisting of cast-iron, and the bell commonly of tin-plated iron sheets. Sometimes in this apparatus signs of destruction are found, principally on the bell and on the closed air vessel.

It is hoped that the author has shown in the paper that the electric currents are of great importance to gas companies, and that they are worth serious observation, with a view to the protection of their property.

[A large number of interesting specimens of pipes which had been attacked by electrolysis were passed round by the author among the members for inspection.]

Discussion.

Mr. LIVESEY at this point again took the chair; and, in

* See "JOURNAL," Vol. LXXVII., p. 947.

opening the discussion, he said the first thing he had to do was to express the very hearty thanks of the members to Dr. Leybold for his most interesting paper, and particularly for his kindness in coming to Glasgow to give them the valuable assistance of his experience in this matter. It was satisfactory in one sense, though unsatisfactory in another, to find that the same troubles gas engineers were suffering from were experienced by their friends on the Continent. The satisfactory part of it was that they were all in the same boat; and they would all pursue the same course until they got thorough protection. The position he thought they could stand upon was this: That the users and suppliers of electricity for any purpose whatever must keep it to themselves —they must not allow it to become a nuisance to their neighbours on any account. If they, as gas engineers, permitted their gas to escape—if it contaminated water, and if it did other things that caused a nuisance of any kind—they were liable, and must make good the damage. This was perfectly right; and all they asked for was that electricians should be compelled to do the same. There was no doubt the Board of Trade would take further action in the matter; but gas suppliers must persevere until they got the full protection they needed.

Mr. James Mansergh, the President of the Congress (who was heartily greeted by the members), remarked that this was a question which was equally important to waterworks engineers as to gas engineers; and he believed the Board of Trade regulations were not satisfactory to either gas or water people. But they had this comfort. He happened to pick up the speech which the Chairman made at the half-yearly meeting of his Company; and he found that Mr. Livesey had been on the "war path" in connection with this subject. He said he was going to keep his armour on, which meant that he was going to continue to fight. They knew the dogged tenacity of George Livesey; and that was quite sufficient to comfort people outside the profession.

The Chairman: James Mansergh will, I am sure, help by doing his part. (Applause.)

Mr. C. C. Carpenter (London), called upon by the Chairman, said he did not know whether the history of the electrolysis question was known so far as the South Metropolitan Company were concerned. It was first brought to their notice by an escape of gas from a 4-inch main, running out of a 3-feet main at Clapham, which made it quite useless for conveying gas. This was the first thing that awakened them to the seriousness of the question of electrolysis. They had been pursuing their investigations in South London for some time; and they found that in the Clapham Road, which was not under the Board of Trade regulations, by cutting the main and inserting an insulated joint, they traced very large currents indeed. The interesting thing was that they had been told by one section of electricians that the Board of Trade regulations were sufficient. The regulations all allowed a difference of potential considerably higher than Dr. Leybold advocated, and probably if they could get down to as low a figure as he gave—something under 1 volt—the possibility of damage would be much less than it was now. What they, as gas engineers, had to do was to be on the watch; and this was a matter in which gas engineers in all towns where there were electric tramways could be of the greatest use, if they would keep a keen personal watch for indications of something in the way of a different kind of corrosion going on than that with which they were familiar, and if they would but investigate and do their share in the business, it could not but conduce to putting the whole matter on a satisfactory basis in the future. Those who had taken up this matter wanted the co-operation of all gas engineers who were associated with towns where these tramways were running, because they were convinced, if the electricians could have their own way in the matter, the damage to gas and water mains would be on a far larger scale in the future.

The Chairman remarked that he was glad Mr. Carpenter had made this suggestion. If any damage was found by a gas engineer, he (the Chairman) would ask him not to disturb it; but to leave it just as it was discovered. If, then, he would immediately report it to the South Metropolitan Company, they would communicate with Professors Ayrton and Perry, who would go down and inspect the pipe. There was a case found in Liverpool; but the pipe was cut out and sent to London. It was no doubt a case of electrolysis; but what was wanted was knowledge as to the exact conditions under which it was produced. He wanted to put this impressively to their gas friends, that in case of any injury by electrolysis, nothing should be touched until the experts had seen *in situ* the mischief done.

Mr. S. O. Stephenson (Tipton) said this was a subject of some interest to him. They had no electric trams or electric mains in Tipton; but nevertheless they found great destruction of the services. He had had the same experience as Dr. Leybold—cast-iron mains were little touched; but a wrought-iron service laid in the ground would be cut and destroyed in a short time. They had adopted a method of protection which differed somewhat from Dr. Leybold's. They adopted a V-shaped trough, and, instead of using tar alone, they employed tar and pitch. He had had these services opened; and they showed no destruction at all. He had had a little doubt in his mind on this subject; but there was electrolysis all the same. There was a large amount of metal in the ground; and he thought electrolytic action was set up between that and the wrought-iron pipe.

The Chairman: Have you electric tramways there?

Mr. Stephenson said they had not; but although they had not electric tramways, still there was electrolysis and destruction of the service-pipes; and they protected them in the way he had described.

The Chairman: Is it from electric lighting.

Mr. Stephenson: No; there is no electric lighting.

Dr. Leybold: Perhaps it is the natural current set up by the metals in the earth?

Mr. Stephenson: Perhaps the idea of mixing tar and pitch, and enclosing the pipes as I suggest, may be of interest to Dr. Leybold.

Mr. Carpenter: The pipes in question in our case were laid in good gravel.

The Chairman: And they were cast iron?

Mr. Carpenter: Yes.

The Chairman: Wrought-iron pipes are always corroding. Are there ashes in the soil, Mr. Stephenson?

Mr. Stephenson: Some of it is clay soil; but it is always the same.

Mr. W. R. Herring remarked that he thought Dr. Leybold had given them a very strong argument with which to plead in the future, either before Parliamentary Committees or the Board of Trade, with regard to this question of electrolysis. It appeared to him (Mr. Herring) it was not the volume of electricity escaping that they need fear. It was the very small quantities of it, assisting and forwarding the natural chemical action of the salts contained in the soil in which their pipes were laid. This was even of more importance than the escape of a large volume of electricity, which would be quickly discovered; whereas the electrolytical assistance given by the natural salts in the earth brought about a general corrosion as well as the pitting of the pipes such as they saw.

Mr. T. Holgate (Halifax) said he should like to ask the author a question. He noticed that Dr. Leybold stated that considerable difficulty had been found through the defective bonding of the rails at Erfurt. He (Mr. Holgate) took it that the difficulty he referred to there was defective mechanical bonding as well as defective electrical bonding. He was told by people who were laying down tramways at present that they found it very necessary to make the ends of the tramway rails rigid, so as to preserve the contact, and to make the cover at that point of equal section with the tramway rail. At a number of towns in Lancashire and Yorkshire, they had introduced a bond underneath the tramway rail which was the same in section as the rail itself, so as not to diminish the sectional area through which the current would pass. It was practically a piece of rail placed upside down, put in concrete underneath, and riveted to the two ends of the rails.

The Chairman: I am afraid that is not enough.

Mr. Holgate said he saw by the paper that Dr. Leybold had got relief by having supplementary cables. In a new installation, would it be better to require supplementary cables or to insist on the proper bonding of the rails, so as to ensure a return of the current to the stations?

Mr. S. Meunier (Stockport) said this question naturally was one they all took a deep interest in. It was of vast importance, because they could not notice very easily where or how damage by electrolysis was likely to be done. Since their tramway system at Stockport was first thought of, and during the progress of the work in connection therewith, he had taken a great deal of interest in this question of electrolysis, with the view, having perhaps a unique opportunity, of endeavouring to take all the steps one could possibly foresee to prevent any damage from this cause.

The CHAIRMAN: Do the tramways with you belong to the Corporation?

Mr. MEUNIER said they did; and his department had to supply the current for them. The question which had been mentioned, and to which Mr. Holgate had drawn attention—that was, the question of bonding—was taken up very seriously at Stockport, because from research into previous work that had been carried out in various towns, it appeared that the bonding was very much worked by rule-of-thumb. There did not seem to be the amount of calculation put into it that was necessary. In connection with this particular point, he noticed, in a paper that was read in America not long ago by a tramway engineer, that they took full particulars of the weight and sections of the rails; but as far as the question of the bond was concerned, they never stopped to see what was the proper ratio of the contact with the rail. He came across some figures the other day to the effect that a 90-lb. rail, with a certain surface, would require a bond equal in area to 6 square inches. This meant practically at least a 1¾-inch diameter bar, so as to get full contact. There were plenty of 90-lb. rails in existence; but there were few places where they put in a bond of that capacity. Another point came in with regard to the insulated cables running back to the stations. They were practically at the top of the surface, and so drew away the current that would be likely to escape from the rails to the pipes in congested parts of the district. The mischief was done to the pipes not by the current coming to them, but by the current leaving them. To his mind, the greatest value of this paper of Dr. Leybold's was that it practically corroborated the investigations that had been made from time to time by other gentlemen, and especially it showed them distinctly that it was not so much the amount or the pressure of the current as the fact that it could be started, and once started it could be kept going by a very small pressure. Professor Jackson (of America, he believed) found that he could start electrolytic action in a suitable soil containing salt and water with a pressure as low as the 1oooth part of a volt. It took, of course, a certain amount of time to have an appreciable effect; but, when once started, it would undoubtedly seriously affect gas-mains in the course of time. Everything one could see seemed to point to the conclusion that uninsulated returns ought never to have been allowed. Although at the same time they might not like it very much, it would seem to be a sort of dog-in-the-manger spirit to try to starve out another branch of engineering of a useful character to the general public, and create for them further difficulties in the towns in which it had started. However, no doubt the leading tramway engineers and electrical engineers had their eyes open to this important matter, and they would do their best, he had no doubt, to meet the views of gas engineers, and do as little damage as they could. Still, he thought the first thing they, as gas engineers, had to do was to look at home; and he considered the suggestion thrown out by Mr. Carpenter, and further emphasized by the Chairman, was a good one—that wherever they noticed this kind of thing, wherever they thought there was a probability of electrolytic action in any shape or form, it should be taken full note of, and proper investigation made at once. If they could only manage as a body to put all these facts before the proper people—the Board of Trade—the more they could do, and the quicker they did it, the sooner they would get an alteration of the regulations, which sorely needed altering for the better protection of gas and water authorities.

The CHAIRMAN: We want evidence; that is the thing.

Mr. GISBERT KAPP said, as Secretary of the Association mentioned in the paper, the members would perhaps allow him to say something on this question. About two years ago, investigations were made on this subject in Germany. Circular letters were sent round, inquiring of all the gas and water companies in the country as to the damage done by electrolytic action, providing such action was produced by lighting or tramway currents. (He was not speaking of the electrolytic action which one previous speaker—Mr. Stephenson—had alluded to.) If he (Mr. Kapp) remembered correctly, there was a percentage of about 5 or 6 of the companies who replied who gave them any particulars of damage—Hamburg was one. In fact, he had seen in Hamburg a room filled with pipes of the kind which Dr. Leybold had exhibited. Those were fair cases of electrolytic action. On the whole, the result of the inquiry in Germany was rather satisfactory; and electricians were somewhat astonished that there should be so few cases of electrolysis—taking the country all over. He was perfectly in accord that the 7-volt rule of the Board of Trade was absolutely useless for the protection of pipes. He was on the Committee of the Institution of Electrical Engineers when the rules were drawn up. Someone on the Committee suggested that 7 volts would be about right. No one on the Committee then knew much about the question; and so they said that would do. (Laughter.) But now they knew they could pit a pipe with under 2 volts. Still the fact remained that their inquiry had shown a remarkably small percentage of damage. In some cases it was perfectly obvious, like in Hamburg and Erfurt, that there must be damage. In Hamburg, they were previously carrying all the current through the rails near the power station; no return feeders being used. It might be thought that the current having gone out by the trolley might easily get back by the rail, since the conductivity of the rail was perhaps 20 times greater than that of the trolley wire. But this argument was faulty, because the rail was uninsulated, whereas the trolley wire was highly insulated. The fact that so few of the cases in Germany had proved really serious, was simply to be explained by good bonding. A previous speaker had mentioned a sort of mechanical bond under the rail joint; but that was useless as an electrical bond, since rust got between the surfaces. They must have a good electrical bond as well, not only at the rail joints, but also across from the right rail to the left rail, and from the right track to the left. With single-track lines, there should be longitudinal bonding, consisting of an extra wire right along, and connected to the cross bonds; so that, even if both rail bonds at one place went wrong, still the current would find its way round the two defective bonds.

The CHAIRMAN: Is the copper wire continuous?

Mr. KAPP: Yes. It is only a bye-pass in case the bond should entirely fail.

The CHAIRMAN: It is different from anything I have heard of here.

Mr. KAPP said he believed this good bonding was the reason why in Germany there was so little damage done. There was another point the author had mentioned, and that was the return conductors. These were absolutely necessary in extensive tramway systems. But it was also necessary to combine them with boosters, which automatically sucked away the current from the rail exactly in proportion to the load which happened to be on the line at any time. With this system of return boosters (which was in use in Bristol, Sunderland, Glasgow, Berlin, Naples, and other cities), it was perfectly easy to keep the pressure on the rails under 1 volt, and then no fear need be entertained as to the safety of gas and water pipes as regards electrolytic action.

Mr. HELPS asked to be allowed to point out how important it was that those engineers who did find evidence of damage should take some steps to let it be seen by those in authority before they disturbed it. He had received a copy of the "Electrical Review;" and in an article dealing with the Congress, these words appeared: "Dr. Leybold's paper on 'The Electrolysis of Gas-Pipes, &c.,' should certainly bring Professors Ayrton and Perry into the arena. It is also to be hoped that, if they exhibit any dreadful specimens of the awful results of leakage from electric tram-lines, care will be taken to see that the right ones are brought forward, bearing in mind that the Congress is not one of the High Courts of Justice." He thought the members would be interested in hearing this remark of the paper referred to.

The CHAIRMAN said he had to thank Mr. Kapp on behalf of the whole Gas Section for the extremely valuable speech he had made. The gas people did not understand all these things; they had quite enough to do with their gas business. They could not go into all these niceties. It was for the electricians to take care of their currents; and Mr. Kapp had told them how they did it in Germany.

Mr. KAPP: They do it in Glasgow.

Mr. FOULIS: We have not been troubled yet; we are just waiting.

Dr. LEYBOLD, in a few words of reply, remarked that Mr. Holgate wanted to know whether there was any connection of the rails perpendicularly with the destruction at any place. His reply was that the damage was not co-incident with the bonding of the rail; and in the case of the German postage tube (of which he exhibited a drawing) the damage was frequent. In Hamburg they had found that transfering the gas-pipes to under the footpaths was a very good movement. This matter of electrolysis was one of considerable importance to gas companies; and they must take care that they did not suffer great damage from it.

MECHANICAL TRANSPORT OF MATERIALS IN GAS-WORKS.

By William Reginald Chester, M.Inst.C.E., Nottingham.

[A Paper read before the Gas Section of the Engineering Congress, Glasgow.]

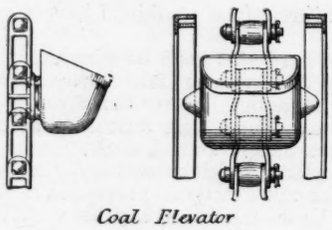
The transport of materials by mechanical means has become a topic of daily increasing interest for the past ten or fifteen years; and to those industries where the handling of bulky and heavy materials is involved, and where the cost of labour has materially advanced, mechanical transport is now a subject of almost absorbing interest. There is scarcely any industry in which it cannot be applied with advantage, either in the manipulation of the raw material or of the manufactured product; and a glance through the catalogues of manufacturers of this class of apparatus will show how varied are the methods, and how infinite are its applications. Each engineer must, however, select the type best suited for his particular requirements. The writer does not pretend to deal with this subject in an exhaustive manner, but to confine his remarks to a description of the apparatus he has found most applicable to gas-works use, to the measure of its capacity in relation to the original cost of the installation, and to the cost of its upkeep or maintenance.

The materials which bulk the largest in gas manufacture are coal, coke and breeze, ashes, purifying material, and sulphate of ammonia. The manipulation of all these, except purifying material, is continuous throughout the 24 hours; and it is, of course, when continuous manipulation operates that the advantages of mechanical transmission are most apparent. The writer has applied mechanical transport to all these materials; and the various apparatus has been in operation for a sufficient time to determine the cost of upkeep with a fair amount of accuracy.

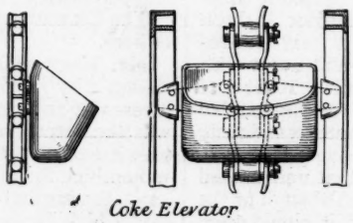
Coal Transport.

Dealing first with the coal plant, this may be divided into three types—viz., the inclined elevator, the horizontal push-plate conveyor, and the horizontal band conveyor.

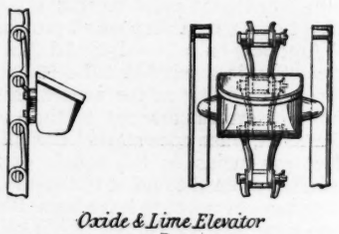
Elevators.—The coal elevators are used for the purpose of raising the coal from the breakers and conveying it into overhead hoppers fixed in front of, and above, the retort-settings. They have been in operation for five or six years, and are fixed at an incline of 50°, having a total length of traverse of about 74 feet each. They are fitted with buckets attached to a sliding bar, the ends of which are covered with cast-iron caps. The caps slide up and down liners fixed to the angle-bar guides; and the track is lubricated with creosote oil. The chief wearing parts are the caps, levers, and sprocket wheels; and these are all easily renewable. The buckets are spaced about 24 inches apart, and each bucket has a capacity of 867 cubic inches, and a speed of 140 feet per minute. The normal rate of work is about 30 tons of coal per hour—*i.e.*, 25 to 35 tons, according to the character of the material passing through the breakers. The writer has five of these elevators in use, which have transported 335,237 tons of coal at a total cost for repairs of £86 1s. 6d., which is at the rate of 0·061d. per ton, or 0·082d. per ton per 100 lineal feet of traverse. The original cost of the elevators complete was about £4 4s. per lineal foot of traverse.



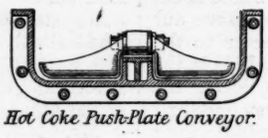
Coal Elevator



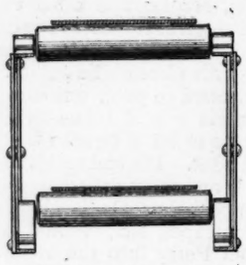
Coke Elevator



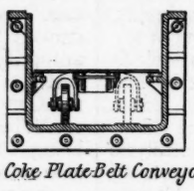
Oxide & Lime Elevator



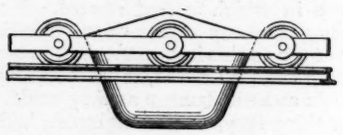
Hot Coke Push-Plate Conveyor.



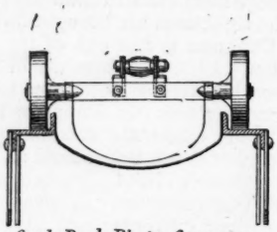
Coal Band Conveyor



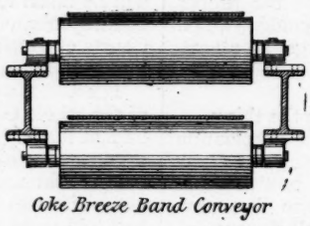
Hot Coke Plate-Belt Conveyor



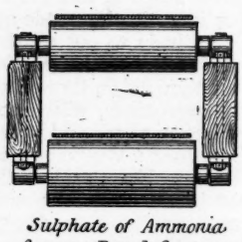
Oxide & Lime Conveyor



Coal Push-Plate Conveyor



Coke Breeze Band Conveyor



Sulphate of Ammonia Canvas Band Conveyor

Push-Plate Conveyors.—The push-plate conveyors receive the coal at the head of the elevators, and carry it forward along the top of the overhead hoppers. The writer has two of these in operation, each having a total traverse of 91 feet. The push-plates are of steel spaced about 18 inches apart, and are carried on rollers running in an angle-iron track. The plates work in a steel trough 20 inches wide, having hinged doors at the bottom for depositing the coal in any particular hopper. The speed of traverse is about 180 feet per minute; and the working capacity is equal to about 40 tons of coal per hour. The total weight of the coal conveyed is 36,536 tons; and the cost for repairs up to now has been £6 0s. 1d., which works out at 0·039d. per ton, or 0·043d. per 100 lineal feet of traverse. The original cost of the conveyors complete was £1159, or £6 7s. 4d. per lineal foot run.

Band Conveyors.—The band conveyors are in use for conveying the coal across the retort-stack from the elevator head to the overhead hopper on the opposite side. There are four of these in operation, each having a traverse of 30 feet. The band or belt is made of cotton canvas 18 inches wide; and it runs on cast-iron rollers at a speed of 250 feet per minute, and has a carrying capacity of 40 tons per hour. The total weight of coal conveyed by these bands is 149,350 tons; and the cost for repairs amounts to £70 6s., which works out at 0·113d. per ton,

or 0·377d. per ton per 100 lineal feet of traverse. The belts being fixed above and across the retort-stack are therefore subjected to considerable heat; and this no doubt is accountable for a somewhat high rate of wear and tear. The original cost was £74 per belt, or £2 9s. 4d. per lineal foot of traverse.

Coke Transport.

The apparatus in use for the transport of coke may be divided into four types—viz., the inclined elevator, the horizontal hot-coke conveyors, (*a*) the push-plate, (*b*) the plate-belt, and the canvas band conveyor for breeze.

Elevators.—The coke elevators receive the coke from the horizontal conveyors working in front of the retorts, and carry it into overhead storage hoppers, from which it is loaded into carts or railway trucks without further handling. There are two of these in operation, which have been working for a period of five or six years. They are similar to the coal elevators, but are provided with larger buckets, and have an inclination of about 50°, with a total traverse of 58 and 72 feet respectively. The buckets are spaced about 18 inches apart, and have each a capacity of 1150 cubic inches and a speed of 140 feet per minute. They are attached to a sliding bar fitted with cast-iron caps at each end, which run on liners fixed to the inside of the angle-iron guides. The track is lubricated with creosote oil; and the wearing parts—viz, the sprocket wheels, caps, and liners—are all easily renewable. The normal rate of work is about 20 tons per hour; and the total weight of coke transported has been 178,541 tons, at a cost for repairs of £679 6s. 8d. This works out at 0·913d. per ton, or 1·405d. per ton per 100 lineal feet of traverse, which is nearly twenty times greater than the cost for wear and tear on the coal elevators. The cost of the elevators was about £6 6s. per foot of traverse.

Push-Plate Conveyors for Hot Coke.—The writer has three of these in operation—two 90 feet each long, for receiving the hot coke as it is drawn from the retorts and conveying it to the foot of the elevator; and one 106 feet long, fixed on the top of the coke storage hoppers, which carries the coke from the elevator head and deposits it in the particular hopper required to be filled. The push-plates are of malleable iron spaced about 24 inches apart. They are carried on cast-iron blocks, which slide along a wrought-iron bar fixed in the centre of a cast-iron trough 27 inches wide. The speed of traverse is about 48 feet per minute, and the working capacity is about 20 tons per hour. The total weight of coke transported per conveyor is 9923 tons; the cost for repairs being £36 17s. 1d., which works out at 0·891d. per ton, or 0·938d. per ton per 100 lineal feet of traverse. The first cost of the apparatus was £1486, or £5 3s. 11d. per foot run.

Plate-Belt Conveyors.—There are five of these in operation for receiving the hot coke as drawn from the retorts and conveying the same to the foot of the elevator. Four of these, running longitudinally in the retort-house, are each 125 feet long; and one, running across the retort-house, is 60 feet long. The belts are continuous, being composed of a series of flat steel plates, overlapping at the ends, and which are bolted to the chain. Both chain and plates are carried on rollers spaced about 3 feet apart, which are fixed on alternate sides of the chain. The belt works in a cast-iron trough 16½ inches wide; and the hot coke is quenched during the traverse. The speed of traverse is 42½ feet per minute, and the working capacity of the belts is about 30 tons per hour. These have been in operation for about six years, and during that time have carried 149,350 tons of coke. The cost of renewals amounts to £2311, which works out at 3·714d. per ton, or 2·070d. per ton per 100 lineal feet of traverse. The first cost of the apparatus was £2026, or £3 12s. 6d. per foot run. The difference in the cost of upkeep for the two types of hot-coke conveyors is accounted for by the fact that the plate-belt conveyor has been completely renewed once, including the cast-iron trough, while the push-plate conveyor has not been in operation sufficiently long to require the renewal of the cast-iron trough. There are, however, considerable signs of wear on this; and it cannot now be long before some portion of it will have to be renewed. The writer's idea is that the cost, when ultimately determined, will be about equal in both cases,—viz., about 1½d. per ton per 100 lineal feet of traverse. Something has to be credited to the cost of 2·01d. for the plate-belt conveyor on account of the present good condition of the trough; while something has to be debited to the cost of 0·938d. for the push-plate conveyor on account of the renewals which the trough in this case will shortly require.

Canvas Band Conveyor.—This is used for carrying back to the foot of the elevator the small coke and dust which runs through the inclined screens over which the coke passes on its way from the storage hoppers to the carts or trucks. The screens vary in width of mesh according to the character of coke being loaded; and all the small which passes through them is taken back to the elevator, raised to the top of the hoppers, and worked through a revolving screen which separates it into different sizes—viz., dust, smith's breeze, and coke for domestic use. The belt, which is made of cotton canvas, is 98 feet long and 17 inches wide, running on rollers at a speed of 135 feet per minute. Its working capacity is about 20 tons per hour. It has conveyed about 10,000 tons of small coke, at a cost for renewals of about £40, which works out at a little under 1d. per ton, and also 1d. per ton per 100 lineal feet of traverse. The original cost of the apparatus was £443, or £4 10s. per foot run, including the underground trough.

Purifying Material Transport.

The apparatus in use for this material consists of two inclined elevators, with buckets which raise the oxide or prepared lime from the floor below to the purifiers, which are fixed overhead. The elevators have each a traverse of 40 feet, and a capacity of about 10 tons per hour when running at a speed of 80 feet a minute. The buckets have each a capacity of 450 cubic inches, and are fixed about 24 inches apart. The elevators have been working for eight to nine years, during which time they have transported 37,685 tons of material, at a cost for repairs of £7 4s., which works out at 0·046d. per ton, or 0·115d. per ton per 100 lineal feet of traverse. The original cost of the apparatus was £428, or £5 7s. per lineal foot run.

Sulphate of Ammonia Transport.

The apparatus in use for this material is an india-rubber belt 110 feet long and 17 inches wide, running on rollers at a speed of 140 feet per minute. It is used for carrying the sulphate from the hydro-extractor to the stores. The sulphate carried has been 2180 tons, at a cost for repairs of £42 1s. 1d., which works out at 4·63d. per ton, or 4·21d. per ton per 100 lineal feet of traverse. The original cost of the apparatus was £172, or £1 11s. 3d. per lineal foot.

The cost for renewal is worked out in every case at per ton of the material transported; but in the case of coke, it must be borne in mind that, when making carbonizing

Mechanical Transport of Gas-Works Materials.

Summary.

Apparatus.	First Cost. Total.	First Cost. Per Foot Run.	Weight of Material Transported.	Distance of Traverse.	Cost for Repairs and Renewals. Total.	Per Ton.	Per Ton per 100 Feet of Traverse.	Description of Material.
	£ s. d.	£ s. d.	Tons.	Feet.	£ s. d.	d.	d.	
Elevators	1554 0 0	4 4 0	335,237	74	86 1 6	0·061	0·082	Coal and cannel
Push-plate conveyors	1159 0 0	6 7 4	36,536	91	6 0 1	0·039	0·043	,, ,,
Band conveyors	296 0 0	2 9 4	149,350	30	70 6 0	0·113	0·377	,, ,,
Elevators	819 0 0	6 6 0	178,541	58 and 72	679 6 8	0·913	1·405	Partially hot coke
Push-plate conveyor	1486 0 0	5 3 11	29,769	2·900 1·106	110 11 3	0·891	0·938	Hot coke
Plate-belt conveyor	2026 0 0	3 12 6	149,350	4·125 1·600	2311 0 0	3·714	2·070	,,
Canvas band conveyor	443 0 0	4 10 0	(say) 10,000	98	40 0 0	(say) 1·000	(say) 1·000	Small coke and breeze
Elevator	428 0 0	5 7 0	37,685	40	7 4 0	0·046	0·115	Oxide of iron and lime
India-rubber band conveyor	172 0 0	1 11 3	2,180	110	42 1 1	4·630	4·210	Sulphate of ammonia

comparisons, the figures given must be divided by 2 to convert them into cost per ton of coal carbonized.

The practical utility of mechanical transport has long since been settled; and it is very easy to obtain the first cost of any particular form of apparatus. But, so far as the writer is aware, this is the first occasion on which the cost of up-keep has been determined on the basis of a comparatively long period of use. The figures are, of course, not absolutely correct to the third place of decimals; but they are sufficiently accurate to enable an engineer to forecast, with approximate truth, what an apparatus of this description is going to cost for maintenance and periodic renewal. The writer has often felt the want of such figures, and will be amply satisfied if the information herein recorded proves of service to engineers who may be contemplating the introduction of mechanical transport into gas-works.

Discussion.

Mr. Foulis said this was a very practical paper, and it contained a great deal of useful information. A good many members had now mechanical appliances; and they would no doubt be able to give some idea of the comparative economy, and test the accuracy of Mr. Chester's figures.

Mr. S. Y. Shoubridge (Sydenham) said he felt the members were greatly indebted to Mr. Chester for having given them the results of the careful observations he had made as to the costs of different forms of conveyors. As he said in the concluding part of the paper, they all felt the need of such data; and they helped them to decide as to the form of conveyor that was best suited to their own particular purposes. He (Mr. Shoubridge) had had experience of some of the types of conveyors shown on the diagrams; and he could fully confirm what the author had said about them. The coal elevators, the push-plate conveyors, and the band conveyors shown on the first diagram had been in use in the works with which he had been connected for a good many years; and he could substantiate all that Mr. Chester had said about them. He had used a coke-elevator similar to the one shown; and he had found it to be all that the author had said about such appliances. He had not had any experience with the particular coke-elevator illustrated, but he had with the De Brouwer, and it had worked exceedingly satisfactorily. But unfortunately his experience had not been long enough for him to give the cost for renewals. It had only been working about eighteen months; and the first renewals were now being made. So it was impossible to say what they would be; but he could not imagine they would be more than was given for the form of coke-conveyor Mr. Chester had shown. They were all, of course, now converted to the necessity for using mechanical transportation; and even if the cost were equal to that of hand labour, he was certain the convenience it was, and the way it enabled them to do without a number of men, would warrant them adopting it in every possible way.

Mr. Charles Hunt (Birmingham), while agreeing in the main with the author, said at the same time it must be recollected that the question of cost largely depended upon whether the machinery was well up to its work or over its work. Therefore, he did not think that anyone putting down one of these forms of conveyors could absolutely depend upon the figures specified being arrived at. He had had for some considerable time elevating and conveying apparatus both for coal and coke; and he supposed in the present day no arguments were needed in favour of the adoption of machinery for the transport of these materials. Dealing first with the question of coke, he might say that as long ago as 1893, they put down a conveyor of the band type. This had been working continuously ever since. At the same time, they applied an elevator and a band conveyor, with screening apparatus, to sort the coke into large, small, and dust. As regards the use of an elevator for coke, he thought he should not advise anyone to go in for one if he could help it; for it broke up the coke, and was not at all satisfactory. He should certainly at the first opportunity do without it in his own case. He was glad that the introduction of the push conveyor had enabled coke to be elevated without the need of an elevator so called. With regard to the band conveyor, quite recently he had to consider whether or not he should extend it or apply a push conveyor; and having regard to the larger number of working parts in the band conveyor, he decided to adopt the push conveyor. They were now engaged in its application for a total length of nearly 500 feet, actuated by a single chain. This he hoped would be in operation in the course of a few months. With regard to the handling of coal, they had had for several years—seven or eight certainly—elevators of 40 tons per hour capacity; and they had been worked up to 60 tons. Nearly the whole of their coal (to the extent of 800 to 900 tons a day maximum) was distributed along the four sides of their large retort-house by means of canvas belts as described by Mr. Chester. These were 21 inches in width; and they worked very satisfactorily. Comparing them with the action of the push conveyor, he gave preference to the band. He thought they cost less, too, in power to actuate them; and, on the whole, where the circumstances were favourable, they cost less for upkeep. He was sorry he had no figures as to the cost, and he feared that, notwithstanding the large scale on which he had been working, the cost of upkeep had been greater in his case than Mr. Chester had been fortunate enough to experience.

Mr. T. Holgate (Halifax) asked to be allowed to put one question as to the use of the oxide and lime conveyor. He did not see any reference in the paper as to the use of a conveyor for these materials; and he should like to know where it had been put into use, and whether it was satisfactory. It appeared to him that it would be rather liable to clog.

Mr. Foulis said that if there were no further remarks, he thought the members would join with him in saying that they were much indebted to Mr. Chester for bringing this subject before them and for giving them so much information, and particularly information as to the cost in detail of the various conveyors and elevators which he had at work. As Mr. Hunt observed, the cost of upkeep depended to a large extent on whether the apparatus had been driven to its full capacity, or whether it was, on the other hand, much in excess of its requirements.

Mr. Chester, in reply, said he felt there were very few remarks required from him in answer to the criticisms of the paper, which at that late hour seemed to be rather sparse. Many gentlemen who had conveying apparatus at work had no doubt some of these types in use; and he did not bring his paper forward so much by way of illustrating the kinds of apparatus, as to establish, in the first instance, the approximate cost of upkeep. Mr. Hunt said that in all probability the cost of upkeep would depend on whether the apparatus was worked to its full capacity, or whether it was worked under its capacity. But it must be borne in mind that the figures he had given in the paper were all actual ones; and the apparatus might be said to be working fairly up to its capacity. He thought the whole thing was summed up in the last column of the paper, where it was put into a unit of traverse per ton per 100 feet, of coal, coke, or other material that was handled. This seemed to sum up the whole thing in a convenient form, whereby any engineer would be able to make a comparison with the work which had been done in Nottingham. The wear and tear on the coke-elevator was, as Mr. Hunt had said, very great; and at first sight there was some drawback to it from the point of view of the breaking up of the coke. But if works where the elevator was in use had sorting apparatus, so as to sort the coke into convenient sizes, the breaking up was more apparent than real, because, as a matter of fact, the smaller coke realized a higher price than the larger coke; and therefore there was no disadvantage in its being broken up to a moderate degree. Mr. Hunt shook his head. Perhaps he did not find that was a fact in his experience, but it was his (Mr. Chester's).

Mr. Hunt: It is not so in Birmingham.

Mr. Chester: Mr. Hunt does not have the marketing of his coke. If he did, he would find his experience fitted in more with his (the speaker's). Continuing, he said that Mr. Holgate called attention to the oxide conveyor. He (Mr. Chester) had not had this at work yet; but he was about to put it down. It was the well-known Hunt [American] conveyor and tipping bucket. He had an arrangement by which that would pass through the centre of the revivifying floor overhead, above the top of the purifiers, and tip the material down through openings into the purifiers as it passed along. It seemed to him to be a convenient way of transmitting the material from the revivifying-floor to the purifiers where it was required. The conveyor would travel along the distance; and they could fill it at any particular point in the length of its traverse. He would, he hoped, be able to get very great advantages from its use. He had no actual experience as to its cost of working; but as it ran on rollers and ordinary rails, he had no doubt it would come out a very economical method of transporting material. Mr. Shoubridge had had a good deal of experience in connection with

this subject, and spoke of the great advantage of mechanical transport in comparison with the ordinary cost of labour. He (Mr. Chester) had left out the question of the saving in labour by the use of mechanical transport, because it would differ very largely in works where the cost of labour varied. But he thought it might be taken as an axiom that, in every case where mechanical transport had been applied, it had done its work at a much less cost than the cost of manual handling of all kinds of material.

APPLICATION OF THE UNIT SYSTEM OF GAS MANUFACTURE TO ITS PURIFICATION.

By Charles Carpenter, M.Inst.C.E.

[A Paper read before the Gas Section of the Engineering Congress at Glasgow.]

Attention has been more than once directed to the fact that the producing plants of the largest and most modern gas-works are built up of units which hardly vary, except in number, from those employed in the smallest undertaking. In other words, standard 10-feet retorts have been found, by the experience of more than half-a-century, to be those best adapted for the complex process of coal distillation in the production of illuminating gas. The somewhat obvious expedient of placing them back to back to economize space—converting them or not as the case may be into "throughs"—does not affect the argument; neither does the practice of lengthening them by a foot at either extremity, as has been done by some engineers. To all intents and purposes, a gas-retort remains pretty much what it has been since the early days of gas lighting.

From the point of view only of carbonizing coal, each retort or unit is independent, and alone or coupled will give, when heated and charged, its maximum duty in, let us now say, thermal feet, rather than pounds of sperm. The modern storage holder renders us independent of this quality. But it exists nevertheless to an extent often unsuspected.

Taking, for example, a works having a maximum output of (say) 5 million cubic feet per day, this would be provided for by 334 20-feet retorts, making at the rate of 7500 cubic feet per mouthpiece per diem. Each 20-feet retort or unit would consequently provide for a variation of 0·3 per cent. in the daily maximum make, if charged regularly throughout the twenty-four hours. It is not, however, usual or necessary, except in the smallest works, to take advantage of so low a factor; and the group forming a single setting is generally substituted. For such a works as described, 56 settings of sixes, 47 of eights, 37 of nines, or 33 of tens would be required. Each setting would therefore give, according to the type selected, variations of 1·8, 2·4, 2·7, and 3 per cent. respectively. The following table puts it in another way.

Table I.

Settings of	Sixes.	Eights.	Nines.	Tens.
No. Working.	Gas Made—Thousands			
1	90	120	135	150
2	180	240	270	300
3	270	360	405	450
4	360	480	540	600
5	450	600	675	750
6	540	720	810	900
7	630	840	945	1050
8	720	960	1080	..
9	810	1080	..	..
10	900	..	..	..
11	990	..	..	..
12	1080	..	..	..

And so on for each million.

So much for the manufacture of gas. If its purification, either in the wet or dry way, is considered, it will be found that the usual conditions are quite different. Taking, again, the example of a 5 million cubic feet works, it will be assumed that tower scrubbers are used for the purification from ammonia. Two of these would be required; a liquor scrubber to work up the strength, and a water scrubber for the last traces. Accepted dimensions would be 20 ft. diameter by 70 ft. high. They would be packed with ¼-inch boards placed on edge ¾ inch apart (fig. 1). The area of such a scrubber would be 314 square feet, of which 78 square feet would be occupied by the boards, leaving 236 square feet for gas-way. The cubic contents would be 21,980 cubic feet, of which 5460 cubic feet would be occupied by the boards; leaving 16,520 cubic feet for the gas-passage. The wetted surface would be 527,788 square feet. (For simplicity of comparison, the timber bearers and distance pieces are omitted from the calculation.)

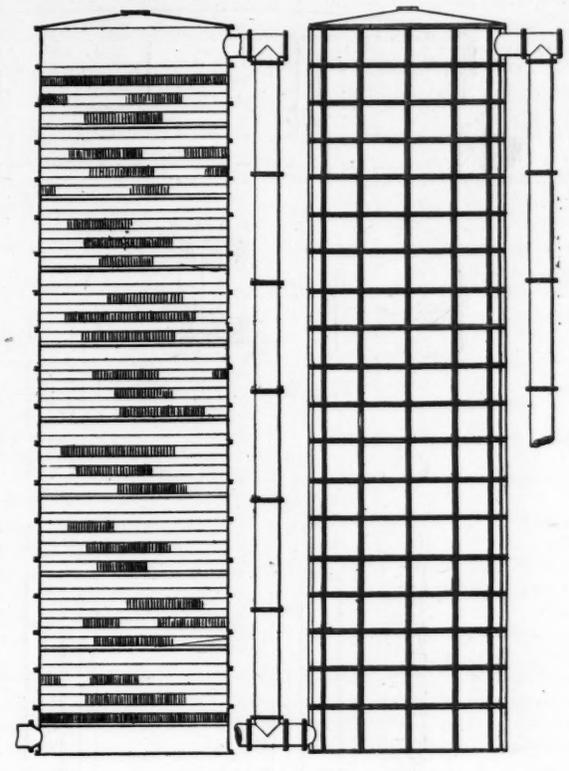


Fig. 1.

Table II. compares the above figures per million cubic feet made per diem in the case of the 5 million cubic feet works for each million between the winter maximum of 5 millions and the summer minimum of 2 millions.

Table II.—*Comparison of Tower Scrubbers and Gas Made.*

Millions per Diem.	Total Area, Square Feet per Million.	Gas Area, Square Feet per Million.	Wetted Surface, Square Feet per Million.
5	63	47	105,557
4	78	59	131,947
3	105	79	175,929
2	157	118	263,894

An alternative to tower scrubbers is the well-known "Standard" washer. The wheels of a 5 million machine (fig. 2) would be 8 feet outlet diameter by 4 feet inlet diameter and 12 inches wide. Assuming the liquor level to be the top of the lowermost bundle, the maximum working area would be 16·9 square feet, the minimum 12·6 square feet, and the mean 14·75 square feet. The plates forming the wheel number 37, and are 0·028 inch thick. The gas area would therefore be 13·52 square feet; and the wetted surface per wheel 2057 feet, or 24,672 square feet per machine of twelve wheels.

The following table is on the same lines as the preceding one for the tower scrubber.

Table III.—*Comparison of "Standard" Washer and Gas Made.*

Millions per Diem.	Total Area, Square Feet per Million.	Mean Gas Area, Square Feet per Million.	Wetted Surface, Square Feet per Million
5	8·6	2·7	4,934
4	10·7	3·4	6,168
3	14·3	4·5	8,224
2	21·5	6·8	12,336

A glance at the second columns of Tables II. and III. shows the very striking difference of practice in the two types of vessels. It appeared worth while to try the experiment of combining to as great an extent as possible the advantages of both. A pair of towers (fig. 3) were therefore constructed for a works having a 2 million winter and 1 million

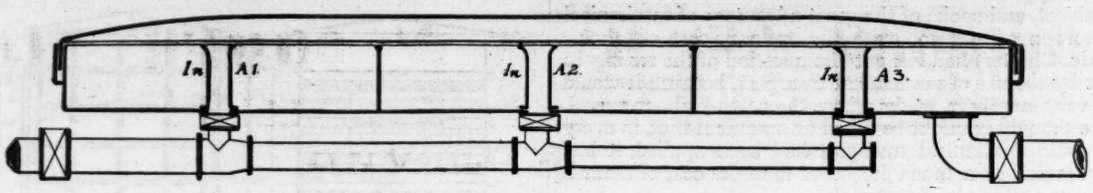


Fig. 5.

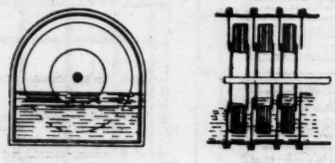
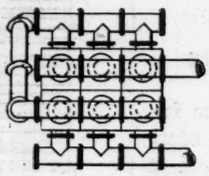


Fig. 2.



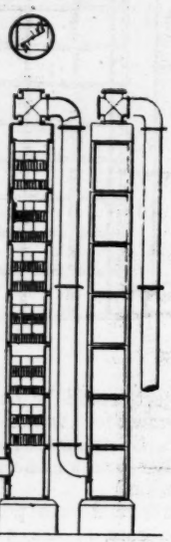


Fig. 3.

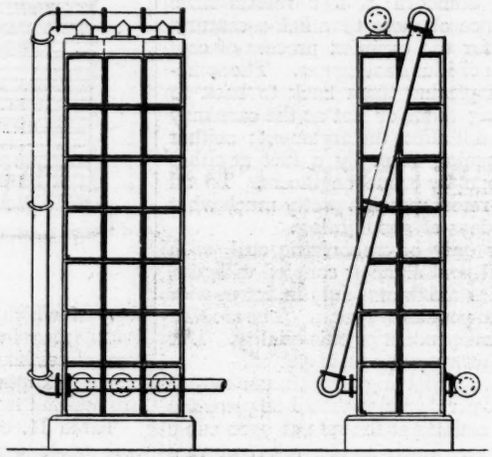


Fig. 4.

summer load. Each tower was made 2½ feet square by 26 feet high, and packed with iron "bundles" built up similarly to those used in the "Standard" machines, but rectangular in shape. Each bundle is 9 inches by 10 inches by 30 inches by 0·036 inch, set in tiers supported upon strips cast on opposite sides of the tower. Three sides of the tower are permanently bolted together, the front or fourth side being of separate plates with distance pieces, so that it can be stripped from top to bottom. The whole of the bundles, if necessary, can be removed and fresh ones substituted in an ordinary working day.

TABLE IV.—*Comparison of Tower Washer and Gas Made.*

Millions per Diem.	Total Area, Square Feet per Million.	Gas Area, Square Feet per Million.	Wetted Surface, Square Feet per Million.
	3·1	2·6	6·075
	6·2	5·1	12·150

The construction is so simple as to readily lend itself to the design of a machine wherein, under varying conditions of gas production, a more constant ratio of scrubbing surface and gas treated can be obtained. For instance, in the case of a 5 million cubic feet works, two rectangular vessels 7 ft. 6 in. by 2 ft. 6 in., divided vertically by two partitions running from top to bottom, or one 7 ft. 6 in. by 5 ft., divided into six vertical chambers, would provide all that appears necessary (fig. 4). Both liquor and water could be used in one, two, or three chambers, according as either was used or the make required. The additional advantages are small ground-space required, absence of motive power, and facility of cleaning. The liquor and water are distributed by shallow perforated trays; but Barker mills, with or without circular tops, could be used if preferred.

The proportioning of plant area to make of gas suggested in the case of scrubbers can likewise be applied to purifiers. The minimum area recommended may be taken at 400 feet super per million feet of gas per diem. In the case of the typical works, this figure would work out as follows.

TABLE V.

Millions per Diem.	Total Area, Square Feet per Million.	Calculated Sizes of Purifiers at 400 Feet per Million.
5	400	20 ft. by 100 ft.
4	500	20 ft. by 80 ft.
3	667	20 ft. by 60 ft.
2	1000	20 ft. by 40 ft.

It is easy, by the addition of diaphragms, to divide up into any number of sections the 100-feet purifier, from the main inlet valve of which connections, with controlling valves, would branch off into each compartment. The proper rate of flow and time of contact could be given as between gas and material independently of the volume of gas being produced. Such a set of purifiers (fig. 5) has been put into operation at the South Metropolitan Gas Company's works; and although the experiment is in its infancy, there is no doubt that the purifying material is more evenly acted upon than is the case with the other vessels.

In conclusion, the author would advocate an endeavour being made to fix the best condition for speed of contact and area in the purifying plant of gas-works, and then to provide means whereby this may be obtained in regular working within the extreme limits of production.

Discussion.

Mr. FOULIS having invited discussion,

Mr. CHARLES HUNT (Birmingham) said he thought the first observation prompted by the paper was what was the advantage to be derived from following the practice of the units advocated by the author. Of course, with regard to gas-retorts, they knew that, so long as they were used, a

considerable advantage was derived from having the unit not too large. But the previous day, they had before them a process of carbonizing in bulk; and therefore that argument was, to some extent, taken away. In dividing up a scrubber or a washer, one could see that there might be some little advantage from the fact that a portion of it was available for repairs, when needed, without throwing the whole apparatus out of order. But that appeared to him to be the sole advantage to be derived. They had always thought that large areas were conducive to economy of manufacture.

Mr. CARPENTER: That is a mistake.

Mr. HUNT, continuing, said he did not see why they should not avail themselves of the total area of a scrubber or a purifier throughout the bulk of the year, putting up with a disadvantage during the minimum of production and consumption. In the case of purifiers, the economy of large areas was very marked, although there was no doubt that with large purifiers (say of 100 feet) the gas did not get quite so evenly distributed as it did with those of moderate size; and therefore Mr. Carpenter's proposal might well be adopted with advantage, so far as that was concerned. Assuming they had a 100-feet purifier, there was a certain amount of difficulty in distributing the gas evenly throughout so large an area; but limiting the area of the purifier to somewhere about half the dimensions, he failed to see that any additional economy would be derived by still further reducing the area, as proposed by Mr. Carpenter.

Mr. S. Y. SHOUBRIDGE (Sydenham) said he would like to thank the author for bringing forward the paper, because he was of opinion that it was desirable that all parts of their plant should be proportioned to the make of gas. He thought that, in the majority of the older works, the plant had not been—at any rate, the scrubbers and washers—designed to suit the conditions of the work, but had been put in rather empirically; and by directing their attention to the necessity of this, he thought that Mr. Carpenter was doing a very good service to the profession.

Mr. G. R. HISLOP (Paisley) said he had only a few observations to make regarding the paper. They were certainly very much indebted to Mr. Carpenter for bringing it forward. With regard to tower scrubbers, he did not think the necessity existed, to a great extent, of reducing the area in summer, compared with winter, because they had higher temperatures in the summer time, and there was not so much fear of over-scrubbing in that period. The same might apply to purifiers, although, certainly, there would be some advantage in reducing the number of purifiers during the summer months, because passing the gas through too large an amount of purifying material might tend, especially with the richer gases, to reduce the illuminating power. He attached the very greatest importance to the sectioning of part of the purifying apparatus and condenser. He maintained that in many cases, especially in the smaller works, a very great mistake was frequently made in passing the gas through the same condensers summer and winter. It was of the greatest importance, he contended, to have at least three divisions of condensing plant in every gas-works, however small, so that it could be arranged according to the temperature and the quantity of gas being produced. He thought that more mischief and loss were occasioned by over-condensation in that way than in any other department of gas manufacture. He had had very many cases of the kind brought under his notice. He was convinced that in some instances they were losing not less than six candles of illuminating power by over-condensation; and he should say it was a very easy thing to lose half that in the case of English gas. He attached considerable importance to sectioning the condensing power of the gas-works, in order to get the power required at the different seasons of the year and for the different qualities of gas manufactured.

Mr. H. E. JONES (London) said he had not had the advantage of hearing the paper read, but he had had conversations with his friend Mr. Carpenter which enabled him to know pretty well what was in his mind. He rather joined issue with Mr. Carpenter on what Mr. Hunt had alluded to; and if he occupied their time he would not be doing right, because Mr. Hunt had practically voiced his experience in the matter referred to. With purifiers, and especially lime purifiers, the larger area they had, there was undoubtedly a greater economy, both in lime and labour. He had been almost staggered of late by some experience he had had in his endeavours to continue the use of purifiers at a large works which were nearly suspended in the summer time, and therefore the amount of gas passing through the purifiers was not more than 25 per cent. of what it was in the winter. He had therefore come to the conclusion that they would do well to reform their views about purifier areas. He had great faith in the old coke scrubber. Very little improvement was to be made on that if they wished or had to meet extreme requirements in the matter of ammonia purification. Where they were microscopically tested, and when they had accomplished purification, they naturally had great confidence in the means they employed. He stuck up well for the old coke scrubber; but he liked to make it fat and wide and not too tall. (Laughter.) He should like to send some of his figures to Mr. Carpenter, and discuss them with him. But certainly his experience of lime purifiers was that they could hardly have too much area for economy. Of course, there was an economy of interest on capital, which they must regard. In London, owing to the dislike to have gas-works in populous places, and owing to their fatal habit of trying to turn out too much gas on a limited area, he thought that they had got below the rules which really gave them the best economy in manufacture.

Mr. J. W. HELPS (Croydon) said he would like to make a few remarks on this paper, and in doing so he was afraid he must somewhat differ from the remarks both of Mr. Hunt and Mr. Jones. The paper of Mr. Carpenter's was not simply a set of theories which the author had brought forward without having fairly tested them, and without being satisfied whether he was right or wrong, as to the effect that had been produced by the introduction of this system. He knew, from conversations with Mr. Carpenter, that he had for some time past been trying this system of sectioning; and he knew that he had been able, with these small scrubbers, for instance, to do all that was absolutely necessary for producing a gas perfectly freed from the impurities that were dealt with in the apparatus. Now, if he was able to thoroughly purify the gas from ammonia with these small scrubbers, did that not go to prove that they were using scrubbers generally much larger than was really necessary?

Mr. HUNT: No.

Mr. HELPS said it appeared to him that it did. With regard to the purifiers, Mr. Hunt had stated that they could not, within reasonable limits, have their lime purifiers too large. Now some years ago, he was working purifiers of a certain size, and was getting a certain result per yard of lime. By-and-bye his make increased, and his great difficulty was back-pressure. He then coupled up the purifiers, which were 24 feet square, each worked in rotation, and converted two of them into one of 54 feet long by 24 feet wide. After having increased very considerably the area, and consequently the time of contact, he never got such a good result per yard of lime as he did with the smaller purifiers. The difficulty he had was not a question of purifier; it was more a question of back-pressure. The trouble, of course, was, with a large purifier, especially in the summer time, that it was, so far as they saw, a matter of some difficulty to so carefully and thoroughly slake the lime. The whole of the lime existed under absolutely the same conditions; but the gas seemed to find its way, in going so slowly, through the parts that could be traversed easily. When they cleared out these large purifiers, he found them very patchy. He could not help thinking that the time was coming when they should adopt the system of sectioning to a greater extent than they had done in the past; and he was sure they were very much indebted to Mr. Carpenter for having introduced the subject in the way he had done. Whether he was right or wrong, he had carefully gone into the matter, and good must, he thought, come out of it.

Mr. JONES said he should like to mention that, with large purifiers, especially of great area but with a limited area of pipe into them, the question of distribution came in; and in such cases, he had found the patchy condition that Mr. Helps had referred to, especially where the distribution of the gas at the inlet was not carefully seen to. His plan was to make a shallow trough along from the inlet-pipe to circulate the gas. He made side openings in the shallow trough to ensure the gas being spread over the whole of the purifier.

Mr. A. WILSON (Dawsholm) said that in the working of the purifiers they found that, when they had too large an area, there did not seem to be quite the same chemical action. When gas was passing through too slowly, the temperature seemed to go down, and they did not get the same value from the lime. In the works in Glasgow (designed by Mr. Foulis), the sectional idea was carried out to a great extent, but perhaps not to the extent indicated by Mr. Carpenter.

Possibly the members noticed, when they were going round the works at Dawsholm, that their condensers were fitted with valves at the inlet and the outlet of each line of pipes. In a condenser for 5 million cubic feet per day, they had ten lines of pipes; and so they could reduce the area in proportion to the gas passing through. The temperature in the condensers was taken regularly every hour by the foreman; and as the temperature varied, more or less lines of pipes could be put on or off as required. In their scrubbers, there was not the same latitude allowed for varying. But still the work was sectioned up to a large extent. In their purifiers they had a great many sets of fours, which they put on or took off according to the make; and they found in the summer time they had to shut off a great many sets of purifiers, otherwise they would not get the same results from the lime. However, extending this system too far—making the units too small—would increase the capital account to a great extent, and would require more area than they could get in large towns, except where they could start new works and secure plenty of room. In all other works, he thought, the bugbear was the want of room, and small units. There might not be a great deal more room in new works; but the unit idea could be carried out in them much more economically than in old works.

Mr. Foulis said he was sure they were all very much obliged to Mr. Carpenter for bringing so interesting a subject before them in the way he had done. He must confess that, in designing new works, there was always a very considerable difficulty in knowing exactly what size to make the apparatus. Any rules or data they had were more or less modified to such a large extent by the different material they had to deal with, and by local circumstances, that they failed to apply to them in individual cases. His own impression was that they could not have too much area in their purifiers; but he was decidedly of opinion that there was a limit to the size at which they could economically work the purifiers. He thought a purifier 100 feet long would be a most unmanageable thing. Another consideration was that, if they had a purifier so large as that, when it was shut off for cleaning, it meant a large section of the works being thrown off at one time. So that he did not see how they could carry on their work economically, because they must provide apparatus sufficient for the purpose; whereas, if they had smaller houses, then the proportion of the works thrown out was much less. He thought they were much indebted to Mr. Carpenter, and they should be very glad to hear what he had to say in reply to the discussion.

Mr. Carpenter said that, replying to Mr. Hunt, who asked what was the good of all this, he would say, in the words of the President of the Congress, that the engineer was he who did for half-a-crown what other people did for five shillings. Those who looked at the diagram—which was a scale one, and in which was shown the views of tower-scrubbers of a certain accepted design—and noticed the "Standard" washer, could not fail to be struck with the enormous difference in the area occupied by each; and if these dimensions were worked out in wetted area, as they had been in the paper, he did not think they could fail to be struck with the enormous discrepancy. The advantage of the "Standard" washer was well known. He should think it was one of the most favourite types of washing machines with which engineers were familiar. The objection to it was, as was well known, the fact that it had to be kept continuously in motion by mechanical means, and there was more or less possibility of a slip between one wheel and another. It occurred to him, as he had reason to believe it had to others, whether the advantages offered by the "Standard" machine could not be incorporated in some form with tower scrubbers, and therefore he constructed, as was described in the paper, tower-scrubbers of what might be called the "Standard" type. Instead of mounting the bundles on wheels and revolving them in water, he superposed them in tiers, and treated either with liquor or water, just as in the Kirkham washer. The results proved to him that, whether the system of washing were by iron bundles in "Standard" washers, or whether applied in tower-scrubbers in the way he had done, the advantages were equally great. As stated in the paper, should it be necessary to clear or to renew the contents of one of these towers, it could be done in the ordinary working day. Then came the point that if such towers so constructed would do the work of efficiently purifying the gas from ammonia and working up the liquor strength at the same time, what was the necessity for putting in the enormous tower scrubbers with which, in some parts at any rate, they were all familiar. That was the history of these particular scrubbers. Answering Mr. Hunt still further, the cost of each of these towers—there were two for a make of 2 million cubic feet per day—was £150; so that the complete plant, exclusive of foundations and pipes, would be £300. Whether this figure was lower than Mr. Hunt was able to do it for—either "Standard" washers, or tower-scrubber, or some other form of washer—he was not aware; but it was fairly low. The weight of each of the scrubbers, it might be interesting for them to know, was 5½ tons, and the weight of the bundles was 4 tons; so that each of the towers had somewhere about 9½ tons of iron in it. Mr. Hunt dealt with the question of the economy of large purifiers. He (the speaker) was very pleased indeed to have Mr. Wilson's support on this matter, because Mr. Wilson was in practical daily contact with the routine of a large works, and his words were that he found it very important, and very necessary, in the summer time, when the make was reduced, to shut off sections of the small purifiers, which were so well adapted for the purpose, and to keep in action only those which were required. That was precisely his (Mr. Carpenter's) experience too. In the case of his own Company, the works which did the best with regard to lime purification were those which had a purifying area of from 170 to 180 square feet per million cubic feet of gas per diem; while those that did the worst had about 700 square feet. The reason was not far to seek. It was not, as one would think from what Mr. Jones had said, a question of distributing the gas at the inlet of the purifier; but it was thoroughly preparing it first, and so placing the material afterwards in the boxes, that the lime was of a uniform texture and exposed an equal area to the passage of the gas. His experience had been, in watching the emptying of large purifiers, that the lime was not by any means equally acted upon. If they saw a large purifier opened, and if the top were taken off, it would be found that, owing to the fact that the gas accumulated and rested in the top and played over the whole area of the box, the crust was uniform; but if they dug down into the vessel, his experience had been—and he believed it was that of other gentlemen—that, judging only from the colour of the lime, which was a very good test after all, the amount of gas which was passed through the different parts of the boxes varied all over the contents of it.

Mr. Foulis: What are the sizes of the boxes you are referring to?

Mr. Carpenter said the size of the boxes he had in his mind were those the area of which was about 600 or 700 square feet per million cubic feet of gas per diem. He need not labour the point any further, but let him again say that, whether it arose from that cause or not, there was the fact that, with an area limited to 170 or 180 square feet per million, they got in those works better results per ton of coal carbonized, and, what was still better, per 1000 cubic feet of gas made, than where they had a much greater area. Although it was perhaps taking the paper backwards, an endeavour was made to see whether at one of their larger works it would not be possible to get some of the advantages which a smaller area of purifier was known to give; and, as was shown in the drawing, a set of four lime purifiers was split up by means of diaphragms, and additional inlets were placed to them after the inlet valve, enabling them to put one, two, or three sections into operation, as the case might be. They had been working at that some few months now. When the make was at its minimum, they filled the boxes *de novo*, and they opened "A1" as it was called. When it was saturated, they opened "A2," and when that was saturated, they opened "A3." During the period of maximum make, the whole of the three valves were open. He was sorry to say that he could not give the meeting any definite figures of gain or loss; but this he could say, from personal observation, that the appearance of the lime came more nearly to that where they had the smaller purifying area. With regard to what Mr. Hislop said, he was sorry to say that in one respect he had no experience with gas which lost so much of its quality under the adverse influence of condensation; but he quite agreed with him as to the importance of keeping the condensing under control. So impressed had he been with this, that he was coming to the belief that, at any rate where water was available, the whole condensation should be carried out by means of water-cooled condensers preferably to any other way; the reason being that it was so very easy to vary or increase the flow of water through the condenser, and use the whole of the apparatus, and simply vary its capacity by the amount of water going

through it. But the question of atmospheric influences came in very largely. Whether or not it was owing to the high temperature in the summer rendering the ultimate purification from ammonia difficult, or whether it was the low temperature in the winter throwing down from the gas the hydrocarbons which it should carry forward, he thought it would be better—and it was a plan which he was now carrying out—to jacket the outlet portions of the condenser, so as to preserve it from extreme fluctuations of temperature; and then, if the cooling were done by means of water, it was possible, even under the extremes of winter and summer temperatures, to keep the outlet temperature line as level and as high or as low as they desired it to be. One gentleman spoke of the importance of a large area in increasing the time of contact. Well, they did not increase the time of contact at all by large purifiers—at least, so far as his experience went—from the fact that the gas did not go wholly or regularly through the large area. Only a portion of the lime in the purifier was really being exposed in its best condition to the gas. That also was borne out by what Mr. Wilson said in regard to the temperature at which purification took place. It was essentially a temperature question; and, as was well known, chemical reactions ceased when low temperatures were approached. It was very important, so he had found, in the question of purification, to avail oneself of (to conserve) the rise in temperature which the reactions in the purifiers themselves brought about—to conserve that and to render the succeeding actions more certain and more regular.

Souvenir of the Visit to Granton.—In connection with the visit of the Institution of Gas Engineers to the new gas-works of the Edinburgh and Leith Corporations at Granton, of which a description appears elsewhere, Messrs. Graham, Morton, and Co., Limited, of Leeds, the Contractors for the retort-house, distributed a tastefully prepared *souvenir*, consisting of 24 reproductions of photographs, lent for the purpose by the Engineer (Mr. W. R. Herring, M.Inst.C.E.), showing the character and progress of the construction of the installation of inclined retorts. They are preceded by a brief description of the work comprised in the contract, extracted from the specification. This is fully dealt with in the article above referred to, for some of the illustrations in which we are indebted to the Contractors. It may be mentioned here, however, that the first brick was laid on the foundations on the 8th of March last, and the dates given show at a glance how the work proceeded.

"O'Connor's Gas Engineer's Pocket-Book."—In the "JOURNAL" for Feb. 1, 1898, we briefly noticed the publication of the above-named work by Messrs. Crosby Lockwood and Son. Its contents, it may be remembered, comprise tables, notes, and memoranda relating to the manufacture, distribution, and use of coal gas and the construction of gas-works, collected by Mr. Henry O'Connor, Assoc.M.Inst.C.E., of Edinburgh. The book has been so well received that a second edition has been issued, and a copy forwarded to us by the publishers. The text has been amended where it was found necessary, and it now includes the statutory regulations for testing the illuminating power and purity of gas. In the preparation of the new edition, opportunity was taken to correct some errors which had unfortunately escaped notice, some of which were pointed out in our columns at the time; and there may possibly be room for further revision. On the whole, the work contains a mass of reliable information, collected, as the author acknowledges, from "every available source." We trust he will find continued appreciation of his labours.

Oil for Gas-Making Purposes in Germany.—The "Petroleum Review" says the Düsseldorf Chamber of Commerce have recently petitioned the German Ministry of the Interior for the abolition of the import duty on oils used for gas-making purposes. It is pointed out that the loss to the Government would be very little, as, at present, gas oil is imported in very small quantities, and the import of it could not possibly be increased so long as the duty exists. On the other hand, by abolishing the duty, the Government may obtain from petroleum-exporting countries preferential treatment for various German products. The Chamber of Commerce addressed a circular to all the German gas-works in towns of more than 10,000 inhabitants, numbering about 400, asking their views on the matter. As a result, it has been ascertained that there are only six gas-works at present using gas oil, and which consume 1,900,000 kilos. In order that carburetted water gas should not cost more than coal gas, the price of gas oil should not exceed 7 marks, or at most 8 marks, per 100 kilos. The remaining gas-works do not use oil gas at present; but a considerable proportion would be inclined to do so, though they are now prevented from employing it on account of the high price of oil. This is due to the import duty; and consequently their works are not being adapted to it. The remaining gas-works, however, did not state that they were in favour of the adoption of gas oil, though in the majority of cases they raised no objections against it. Only 21 gas-works declared themselves as not in favour of gas oils for enriching purposes.

ESSAYS AND REVIEWS.

THE INSTITUTION OF GAS ENGINEERS IN EDINBURGH.

THE International Engineering Congress being in Glasgow last week afforded a fitting opportunity for the holding of the autumn meeting of the Institution of Gas Engineers in Scotland; and so the members visited their President, Mr. W. R. Herring, at his home in Edinburgh on Monday—the day preceding the opening of the Congress sittings in Glasgow. There was something strikingly attractive about the invitation which was so cordially extended to the Institution by the Edinburgh and Leith Gas Commissioners, on the initiative of Mr. Herring. Modest as he has personally been in making public reference to the work to which he has put his hand at Edinburgh, the fact that the concern of which he is the official head is the property of a public authority has brought to the knowledge of the gas profession, through the proceedings of the City Council, the extensive character of the new undertaking, and the information that it contains many original features, and compacts within its scope the ideas of a young but proved, energetic though cautious, and progressive but sound gas engineer, whose work has already earned for him renown and a high place in the respect of his compeers. Many, therefore, have been possessed by a desire to visit Granton; and those of the Institution who were fortunately able to accept the invitation, regarded it as an opportunity not to be missed. What they saw at Granton rewarded them; and the distinguished confidence in which they found their President is held by the Gas Commissioners gave them supreme satisfaction.

AT GRANTON.

The *rendezvous* on the morning of the visit was the Princes Street Station in Edinburgh; and on the platform from which the special train was to start for Granton, something like sixty members, including friends, three of whom—Herr Irminger, M. Suppleson, and Mr. Olaf N. Guldlin—were from abroad. A very few minutes' run brought the party to the station which is being erected on the Granton works for the special convenience of those who will in the near future find daily occupation there; it having been decided that the weight of argument is in favour of carrying the men to and from the city rather than create a new colony in the immediate vicinity of the works. We cannot stop, nor does it come within our province at the moment, to specify the nature of those arguments, but will proceed with the account of the day's doings. The visitors were grieved to learn that circumstances prevented them from having, as they had anticipated, the honour and pleasure of the presence of the Lord Provost; but their disappointment in that respect was lightened by the warmth of the reception, the hospitality, and the painstaking kindness of the members of the Gas Commission, several of whom met them on their arrival. There were present at this stage Mr. Purves, the Acting Convener of the Works Committee of the Commission; Bailie Manclark, the Chairman of the Finance and Law Committee; Bailie Kinnaird, and Messrs. Jamieson, Maxton, Bryson, Fisher, and Gray. Mr. James M'G. Jack, the Clerk to the Commission, Mr. J. S. Gibb, the Treasurer, and several of Mr. Herring's staff—viz., Mr. A. Masterton, Mr. H. Gracie, and Messrs. Davie, Taylor, Oakley, Farquhar, and Stiven—one and all did admirable service in looking after the comfort and supplying information to the visitors.

It is unnecessary here to give an account of all that the visitors were privileged to see, as the almost completed section of the new works scheme is described in a special article on pp. 644-49, and Mr. Herring's paper before the Gas Section of the Engineering Congress will supply further details of the carbonizing plant. It may, however, be said that not one word of adverse comment was heard to pass the lips of any engineer present—the simple fact being that, though the works are in process of construction, and consequently the character of the work is open to scrupulous observation, Mr. Herring has left no weak points for the captious critic to fasten upon. The bold elevation and picturesque style of the architectural work were greatly admired. Parenthetically it may be remarked that Mr. C. E. Brackenbury, who was taken somewhat to task by certain members at the last meeting of the Institution for advocating a little ornateness about gas-works structures, could have pointed to a splendid illustration here, and shown how Mr. Herring has secured what he (Mr. Brackenbury) advocated, at a moderate additional expense to that which buildings of a dull and uninteresting appearance would have cost. Crossing the railway lines in the yard, the visitors assembled in the retort-house, where the President briefly described some of the characteristics of the work. In the base of the retort-house (which has a productive capacity of 10 million cubic feet per day), then along the stage-floor where were seen numerous men engaged in setting the inclined retorts, and later up among the coal-conveying plant and hoppers, and in close proximity to the splendid circular girder roof, the company lingered long, taking in and minutely examining detail after detail; and on every hand were heard expressions complimentary to the Engineer and to the Contractors, Messrs. Graham, Morton, and Co. To the coal-store they then

repaired; and the feature of perhaps greatest interest to them was the operation of the coal-storing conveyor and elevator, and the system which Mr. Herring has adopted for uplifting one end of the railway trucks in order to automatically discharge the contents on to the conveyor leading to the coal breaker and elevator. Smoothness and precision of movement were noticeable points about the machinery. The work in progress in connection with the purifying plant and the gas pumping-house next came in for inspection; and then the 6½ million cubic feet gasholder, which is bordering on completion, and which by the way forms a landmark for miles around, gave rise to a good deal of inquiry. The thoroughness with which the Contractors for the holder have done their work could not pass unobserved. A visit to the bye-products works filled up the interval until the hour when perhaps many of the party were to have for the first time the somewhat uncommon experience of lunching under the dome of a gasholder—and particularly of a holder of the dimensions of this one.

The Luncheon.

Entering the holder by a flight of temporary steps, a strange sight met the eyes of the visitors. The large flat expanse of the dumpling had been partitioned—one side being the "kitchen," fitted with gas-stoves, and the other the "dining-hall." The place was well lighted by the omission of a few of the crown plates. Notwithstanding the strangeness of the surroundings, amid the tank-framing supporting the huge crown, the company were entertained in a regal manner by the Gas Commissioners; and they showed by their enjoyment how well the preparations had been made and how excellently the adjoining culinary department had done its work in the improvised kitchen. A worthy and sprightly Chairman was Provost Richard Mackie, of Leith; the Croupiers being Bailie Grieve, Bailie Manclark, Mr. Purves, and ex-Bailie Hay. The hosts were represented, in addition to the gentlemen already mentioned, by ex-Provost Wood, of Portobello, Bailie Kinloch Anderson, the Convener of the Works Committee (but who to the regret of his colleagues is unable at the present time, through ill-health, to perform the duties of the office), Bailie Waterston, Bailie M'Kelvie, and Mr. Cameron.

The lunch concluded, there were a few toasts; the usual loyal ones, of course, taking precedence of the toast of the occasion—"The Institution of Gas Engineers." This was proposed by the Chairman, who assured those present that the Commissioners took a very deep interest in the work of the Institution, and they were pleased to give the members a most hearty welcome. He hoped and trusted that, from what they had seen that day, they had all gathered something of the great work which their Chief Engineer, Mr. Herring, had taken upon himself. Having proved his (the Chairman's) clear appreciation of the work of a technical body such as the Institution, he said that he felt such Associations were in every way admirable, and deserved the best encouragement, and more especially so when, as in their own case, the result of their deliberations could not fail to lead to the great and immediate advantage of the community at large. He should not presume, he said, to discuss with those present technical details of the Commissioners' new undertaking; but he should like to say that it did strike one as remarkable that, despite the keen competition of other illuminants, the public demand for gas continued to grow in such marked and unmistakeable fashion. The rapid rise of electricity in popular favour for lighting purposes seemed to have acted as a stimulant rather than as an instrument of harm to the gas producer. This fact showed that, so far from the production of gas being a decaying industry, as the "man in the street" was apt foolishly to suppose, it was really a vigorous growing branch of industry, which was daily finding for itself fresh spheres of influence; and the new avenues of extension were by no means exhausted. He would not, however, pursue this subject, in which those present were so well versed. His function was rather to express the pleasure the Commissioners had had in making the arrangements for the visit that day; and this pleasure was greatly enhanced by the fact that the Institution had elected Mr. Herring to be their President. In Mr. Herring the Commissioners had the highest confidence. To skilled experts such as the members of the Institution were, their visit to Granton must have been an interesting one; and he trusted it had also been an instructive and profitable one. However, he hoped they had enjoyed the visit; and, in his own name and in that of the Commissioners, he gave them a most hearty welcome. He coupled with the toast the name of Mr. Herring.

The toast was enthusiastically drunk; and Mr. Herring, on rising to reply, was rapturously greeted. He said, as the President of the Institution, he had great pleasure in thanking the Commissioners and other gentlemen present for the cordial manner in which they had responded to this toast. As an Institution, they had always been fortunate in being kindly received wherever they had the opportunity of visiting works of interest, and works which were calculated to be profitable to them as individuals from time to time. For the information of those who were unacquainted with the movements and objects of the Institution, he explained them. As the President, and not as an individual associated with the locality, he thought he might say they had been able to combine two events very happily, as they were practically on their way to take part in the great International Engineering Congress which was to be held in Glasgow. It was very fortunate indeed that they had found gas-works which were in so interesting a condition. He thought the works were in that condition which was more interesting to the practical engineer than a finished undertaking; and he was glad to have had the opportunity, as its President, of conducting the Institution to Edinburgh on this occasion. The Provost had eloquently set forth the objects of the Institution, and had also pointed the moral of the duties of the members. They had a great responsibility on their shoulders. Notwithstanding all their competitors, they had found that the demands upon them for gas were greater year by year—not only with themselves, but even in towns where electricity was more costly than in Edinburgh and Leith, the increased demand for gas had been greater since the introduction of electricity than it had formerly been. Hence the reason that these great works were in process of construction. They were intended to ultimately supplant those they had at present; but they would have to maintain their existing works as a winter reserve for some little time yet. Provost Mackie had referred to him from a personal point of view. He (Mr. Herring) was proud indeed to have had the opportunity, and also the responsibility, of carrying out the work now in progress at Granton. Their objects had been to cheapen the cost of their product, and to build works which would not be altogether a disfigurement to the locality.

Another toast was that of "The Contractors;" and it was proposed in happy terms by Bailie Grieve. He remarked that, as those present had inspected the works, there was no necessity to say one word for the Contractors. He was sure the opinion of all was that they had constructed the works with credit to themselves; and he believed their work would give satisfaction to the Commissioners. Mr. Robert Laidlaw and Mr. Clayton (the latter of whom represented the Contractors for the holder) suitably responded.

The next toast fell to Mr. William King, who proposed "The Health of the Edinburgh and Leith Gas Commissioners." He said the Institution had not only been the recipients of most excellent hospitality, but they had had the opportunity of inspecting the magnificent works in course of construction; and they had seen there many points which in process of time would be concealed from view. They could study, for instance, the construction of the gasholder in a way which later on would be impossible. He was sure they were indebted to their hosts for the professional treat the members had enjoyed. They had noticed the adoption of many of the latest and most up-to-date inventions in the gas world; and they must congratulate the Commissioners on the works which they would in a short time possess in their full capacity. At the same time, they must also congratulate them on the choice of their Engineer, and on the excellent work he had carried out. It was to any of them as engineers a trying ordeal to be visited by so many professional brethren; but he was sure that that day their friend Mr. Herring had come triumphantly out of the inspection. His visitors would go away having learnt not a few "wrinkles" from what they had seen, and which they might be glad to adopt in alterations and extensions or new works. But he was certain Mr. Herring could not carry out these works unless he was cordially supported by his Committee. While they congratulated the Commissioners upon the Engineer they possessed, they might also congratulate him upon the gentlemen who formed the important Gas Trust. While thanking the Commissioners, he might venture to hope that, the visitors having behaved themselves so well that day, they might be asked again when the works were completed, and all the interesting processes of gas making they had seen were fully in operation. The toast had an enthusiastic reception on the part of the visitors; and Mr. Purves first replied. In his remarks, he mentioned that the holder in which they were assembled would have a capacity equal to all their other gasholders put together—viz., 6¼ million cubic feet. In about two months or so, they would be able to bring the holder into use; and so the anxiety experienced last lighting season would be much reduced. He expressed the pleasure it would give the Commissioners to show the Institution the works if they would visit them when in operation. Bailie Manclark also replied, and mentioned that the cost of the new works up to the present was about £222,560; and he thought they were cheap at the money. When they had the second works, the outlay would amount to about £400,000. The cost of the ground itself was £124,000; but it would not be necessary for young engineers who were contemplating putting down new gas-works to buy such a large piece of land as they had done, because they might not require it. It might be a long time before the Edinburgh and Leith Gas Commissioners would need all the land they had bought; but still it was well they should have it, because Edinburgh and Leith were very quickly rising. In his concluding remark, he endorsed the declaration of Mr. Purves as to the delight it would give the Commissioners to see the Institution at Granton again on the completion of the works.

The Chairman and the Croupiers were also toasted; and the enthusiastic singing of "Auld Lang Syne" ended the first, and probably the last, luncheon that will ever be served in the new Granton gasholder.

Garden Party at Granton House.

The instruction of the morning gave place to equally high pleasure in the afternoon, when Mr. and Mrs. Herring entertained the members of the Institution and lady friends, with several ladies and gentlemen from Edinburgh and Leith and other parts of Scotland, at a garden party at their residence, Granton House. To be fully appreciated, the superb grounds attached to the house must be seen. They are simply magnificent in their extent and their natural and old-time grandeur. On the lawn in front of the house, the host

THE GARDEN PARTY AT GRANTON HOUSE. MR. AND MRS. HERRING RECEIVING TEEIR GUESTS.'

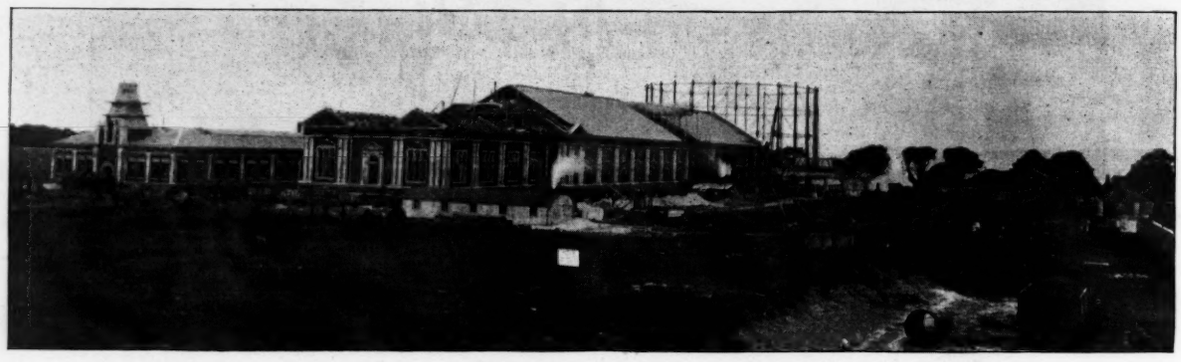
THE GARDEN PARTY AT GRANTON HOUSE. WATCHING THE CYCLE GYMKHANA.

and hostess received their numerous visitors; and very charmingly did they carry out their self-imposed duties in entertaining three hundred or so guests. It was evident that they had given much thought and time to the preparations for the afternoon; and nothing was wanting—not even the fairest of weather—to make the occasion one of complete enjoyment and happiness. Popular music was admirably rendered by the 5th Battalion of the Royal Scots Volunteers; and pipers also assisted in adding to the animation of the constantly changing scene. A cycle gymkhana formed the principal part of the programme and the events were performed in admirable style by the amateur competitors, under the guidance of Mr. Gracie. The winners were afterwards presented with useful and handsome silver souvenirs of the occasion, and of their success. Tea and refreshments were provided in marquees. Happiness and pleasure reigned supreme during the afternoon and evening; and all who were enabled to be present to enjoy the hospitality of Mr. and Mrs. Herring will long retain pleasant memories of this visit to Granton House. Host and hostess and guests bade each other farewell about half-past six,

UP-TO-DATE GRANTON.

JUST as "Beckton" is used colloquially among gas engineers to signify the huge gas-making establishment situated in the dreary area which bears that name, so in time the extensive works which are being erected at Granton for the Edinburgh and Leith Gas Commissioners, under the direction of that Engineer of advanced ideas, Mr. W. R. Herring, will come to be known, without the prefixion or affixture of other words, by the term "Granton." But Granton will form a veritable antithesis to Beckton. In situation, in general arrangement, in equipment from the carbonizing plant down to the system of railways running in and out of the works, and even in respect of minor details, Granton will leave Beckton far in the rear. A sight of Granton and a little conversation with Mr. Herring gives ample affirmation of this. Get Mr. Herring into the midst of Granton, and the fact that his heart is in the works quickly reveals itself. Of every detail he is the master. As he moves here and there, nothing seems to escape his observant eye; and in every quarter his assistants are heard asking advice and instruction on divers points affecting the varied work in progress, and at the same time messages reach him regarding operations proceeding at the old establishments elsewhere. The ready answer, proving the comprehensive mind, comes to all. The reins are in the right hands.

Reckoning from the centre of Edinburgh, Granton is situated some 4½ miles to the north-west. Driving through the intervening country—which brings into charming relief the noble eminences and edifices of (if we may once more use the trite appellation) "Modern Athens"—one becomes convinced of the fact that before many years have run their course the fringe of the city and Granton will have been brought into closer relationship. On the main road which winds its way to Granton through beautiful country, the first evidence is seen of the work in progress elsewhere. Men are observed busily engaged in engulfing in the road, and hiding from view, ponderous lengths of 48-inch mains, which will in due season be employed in conveying the gas made from Granton into the heart and system of the companion districts of Edinburgh and Leith. Along the road, a distant view can be obtained of Granton; and the first thought that strikes the visitor is that, thanks to Mr. Herring's prevision, the new works will not blemish to the extent that the opponents of the site foreshadowed, the fairness which lies around. It was only right and just that, parliamentary permission having been granted for placing the works in such a locality, some consideration should be paid to the "amenities" of the neighbourhood; and no one, unless suffering from hyperæsthesia, will, we



GENERAL VIEW OF WORKS, LOOKING NORTH-WEST.

GENERAL VIEW OF WORKS, LOOKING NORTH-EAST.

feel convinced, be able to say that the buildings give an unpleasant aspect to the landscape. They are in the first section, which is being speeded to completion—and care will be taken to secure harmony in the sections which will follow—built of brick, with terra-cotta brick facing and buff stone relief. For the reason already mentioned, and the varying climatic conditions, as large a quantity of the plant as possible is being placed within buildings. So much for the criticisms which might be passed on the site from the æsthetic point of view.

But we have now arrived on the site itself, and a little information quickly puts us into possession of the considerations which guided to its selection; and, from the engineering standpoint, they are unassailable. Primarily, it offers facilities for making a connection with both the North British Railway and the Caledonian Railway systems, as well as access over private lines to the Granton Harbour or the Firth of Forth—running powers over these having been secured in the original land purchase. Then the subsoil is also of a favourable character for the construction of heavy engineering works. The natural lie of the ground, and its close proximity to the sea, gave easy means of drainage, as well as for the flow of the liquid residuals to the lower level, where the products works have been constructed. The configuration of the site was also such as to require the least possible outlay in levelling as a preliminary to construction; but a greater amount of excavation was required in the construction of the first section than will be needed in any subsequent section. Advantage has been taken of the configuration by embanking the gasholder tank, and placing the purifiers on such a level as to permit of the contents of the boxes being thrown direct into the railway waggons by mechanical means. The coke-yard slopes as much as 1 in 66 from the retort-house outwards. But, notwithstanding all this, the preparatory work was not what one could exactly call light, owing to the extensiveness of the area. One objectionable feature that called for attention was a burn which crossed the site. This had to be enclosed within a culvert, and diverted so as to pass transversely across the centre of the retort-house—clearing the elevator pits, and finally running in an angular direction beneath the coal-store.

The first work undertaken on getting possession of the site was to make railway connections, and to lay the lines permanently in the positions they were to ultimately occupy; the lines acting as feeders for the constructional operations. Simultaneously with the laying of the railways, a permanent drainage scheme was put in hand, which is of such a character as to drain some 70 acres of the site, discharging below low-water mark in the Firth of Forth, and consisting principally of a 24-inch pipe-drain laid at such levels as to permit of the draining of the deepest levels of the machinery, coal-breaker pits, &c. Very considerable advantage was obtained from the construction of this drain in the first instance, by keeping the excavations clear of water—the site being then saturated with surface water. The substratum, however, for forming suitable foundations may, generally speaking, be defined

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VIEW OF THE INTERIOR OF THE RETORT-HOUSE ON MARCH 8, 1901, BEFORE THE ERECTION OF THE SETTINGS AND PLANT.

as good, although of a most varying character; it being impossible to predetermine the nature or the depth of the foundations required for any building, even in the vicinity of other already erected works. Brick-encased concrete therefore entered very largely into the construction of the foundations of the plant and the buildings—the laying of a 4½-inch brick face to encase the concrete in walls above 18 inches thick, foundations for machinery piers, &c., being much cheaper than enclosing it within wooden battens, in addition to which, as the work shows, it makes a far superior face upon completion.

In plotting the works, the guiding principle was to render them as nearly automatic as such an undertaking could possibly be. In the first place, the question of the railway traffic had Mr. Herring's special thought, with the result that it is possible to say that he has arrived at as near perfection in his traffic arrangements as human intelligence could make them. By his plans the indiscriminate collection of materials on sidings, and all the consequent hindrances to the free and easy procedure of the ordinary operations of the works, will be unknown. On the contrary, all the work in connection with the incoming and outgoing traffic will proceed with that smooth regularity and precision which assist so largely in the economical conduct of such large establishments.

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VIEW SHOWING THE CIRCULAR GIRDER ROOF OF THE RETORT HOUSE (JUNE 21, 1901).

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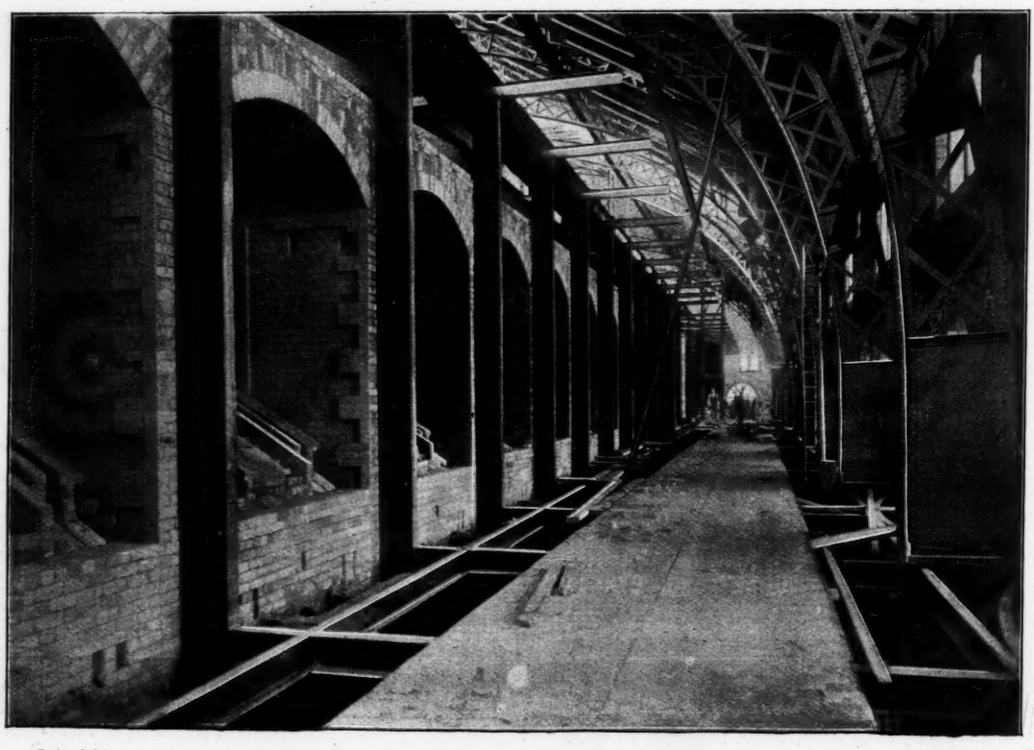
THE FURNACES, WITH FRAMEWORK OF STAGE-FLOOR ABOVE (JUNE 28, 1901).

His arrangements are the fruit of experience, and merit fuller notice. Without going into detail, it may be explained that the traffic coming on either line will be marshalled into the general sidings by the Railway Company's engines. The trains will then be picked up by the Commissioners' own engines, drawn over weighbridges (of which there are two), and then the different classes of coal and other stores will be shunted on to their own particular sidings. Hydraulic capstans are to be used for the manipulation of the trains on the sidings. In connection with the actual operation of gas manufacture, the traffic is arranged so that the supply of coal to the retort-houses cannot in any way impede the transportation of coke and refuse—the coal traffic being conducted along sidings passing down between the retort-house and the coal-store. The waggons are discharged at the centre of the retort-house, and are passed forward in a northerly direction to a point where the solid residual products are placed in position for loading by the automatic apparatus provided. In the event of the supply of waggons being at the moment in excess of requirements for the latter purpose, they will simply pass forward to the sidings for empty waggons ready for removal. In other words, the incoming will never impede the outgoing traffic ; and when the seven retort-houses are constructed, the feeding of the last one will in no way block the operations in connection with the first or those in the centre.



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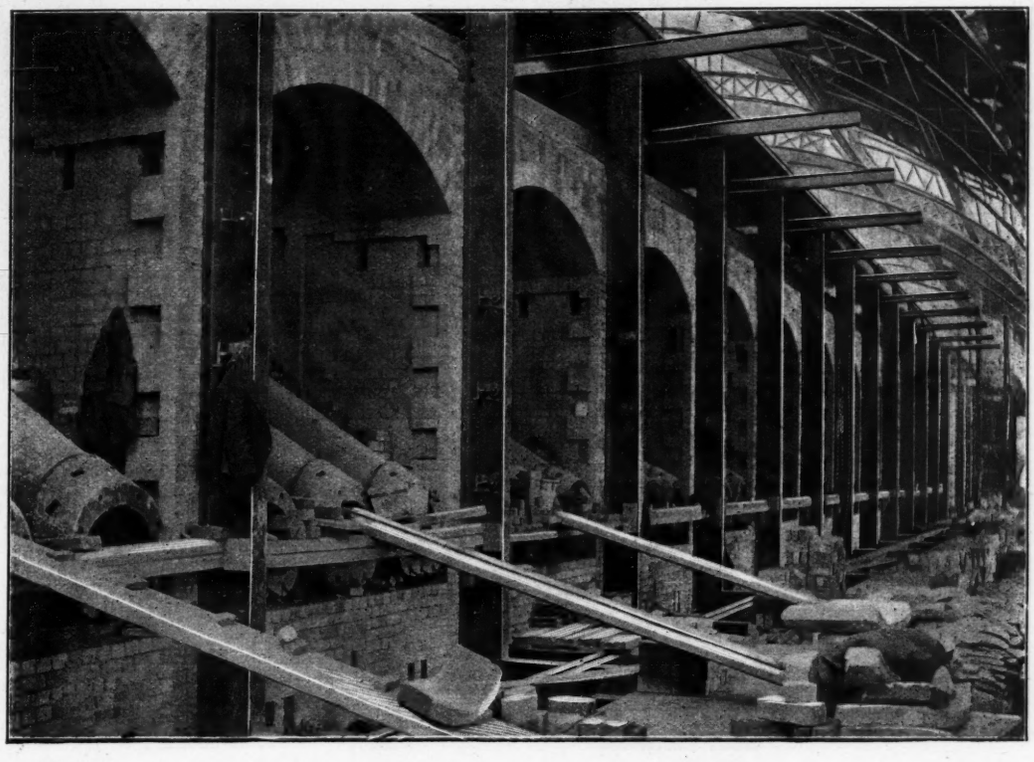
ARCHES FOR THE INCLINED RETORTS (JULY 19, 1901).



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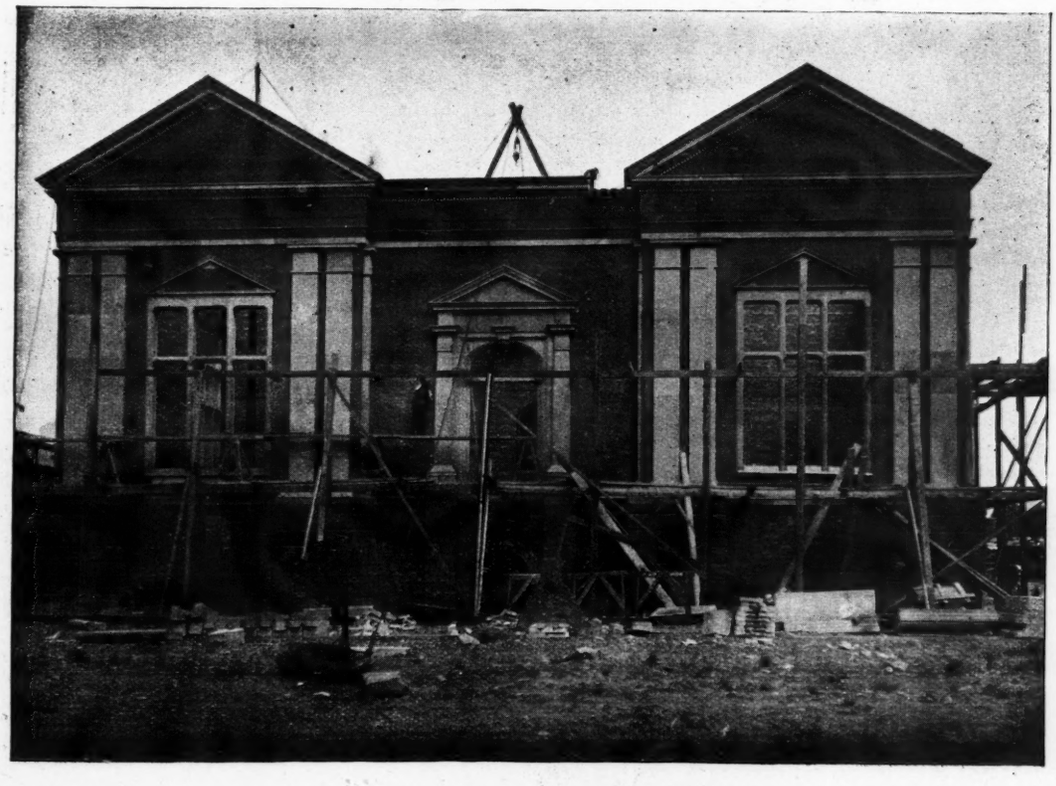
VIEW OF ARCHES, SHOWING RETORTS IN POSITION (AUG. 2, 1901).

While speaking of the traffic, it will be convenient to mention briefly the power it is proposed to use on the works. Steam will be generally employed for motor purposes; hydraulic power for the railway capstans and waggon dischargers; compressed air in the motors driving the discharging apparatus in the purifying-house as well as in the salt-water pumps situated on the shore; and gas power in the pumping-station employed in driving the gas into the towns.

Reverting to the railway arrangements, excellent provision has been made for bringing the workmen from the town and suburbs; and, from what we hear, it is probable that the men will be conveyed to and from their work free of expense to themselves. In fact, though everything is not yet definitely settled, the conditions of those who will labour at Granton will, we are sure, be all that the men can desire. A railway station has been built within the boundary of the works nearest the railway, so that the men will be landed direct on to the scene of their labours. The platform is 140 yards long, having at about the centre a time-checking office, foremen's and general traffic offices on the ground floor, and above, and overspanning the line to the boundary wall, a room 100 feet by 45 feet over all is provided for, which is to be used for general stores and joiners' shops. The workmen on landing



SOUTH END OF EXHAUSTER AND RETORT HOUSE.

from the train will pass through turnstiles, where their time will also be checked. Then they will ascend the staircase, and cross, by means of a footbridge, the eight or nine lines of railway intervening between this part and the central yard.

We now come to a large block of buildings, comprising the retort-house, 386 feet by 100 feet span, and an annexe measuring 110 feet by 80 feet. The latter consists of the condenser-houses, mess-rooms, lavatories, with water-storage tanks above, engine and pump-house, with gas exhausters and engines. In the front portion of the block, and on the basement floor, the engines for driving the coal breaking and elevating plant, and the coke-yard apparatus, will be fixed, as well as the hydraulic pumping-engines; while the gas exhauster and engines are situated on the upper floor. The ground floor of the inner part nearest the retort-house contains blacksmiths' shops, as well as two sets of water-tube condensers, each for 5 million cubic feet per day. The first floor of this building comprises the workmen's mess-rooms, on one side, and the lavatories, bath-rooms, &c., on the other; together with the foremen's offices, and a gangway leading from the exhauster-house to the central stage of the retort-benches. Above the mess-

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TWIN ELEVATOR FROM COAL-BREAKER.

rooms and lavatories, water-tanks, 60 feet long and 35 feet wide are being erected, one for fresh and the other for salt water; the latter being used for condensing purposes, as well as for baths. The tanks being 6 feet deep, it is proposed to arrange for the salt-water one to be used as a swimming-bath for the men.

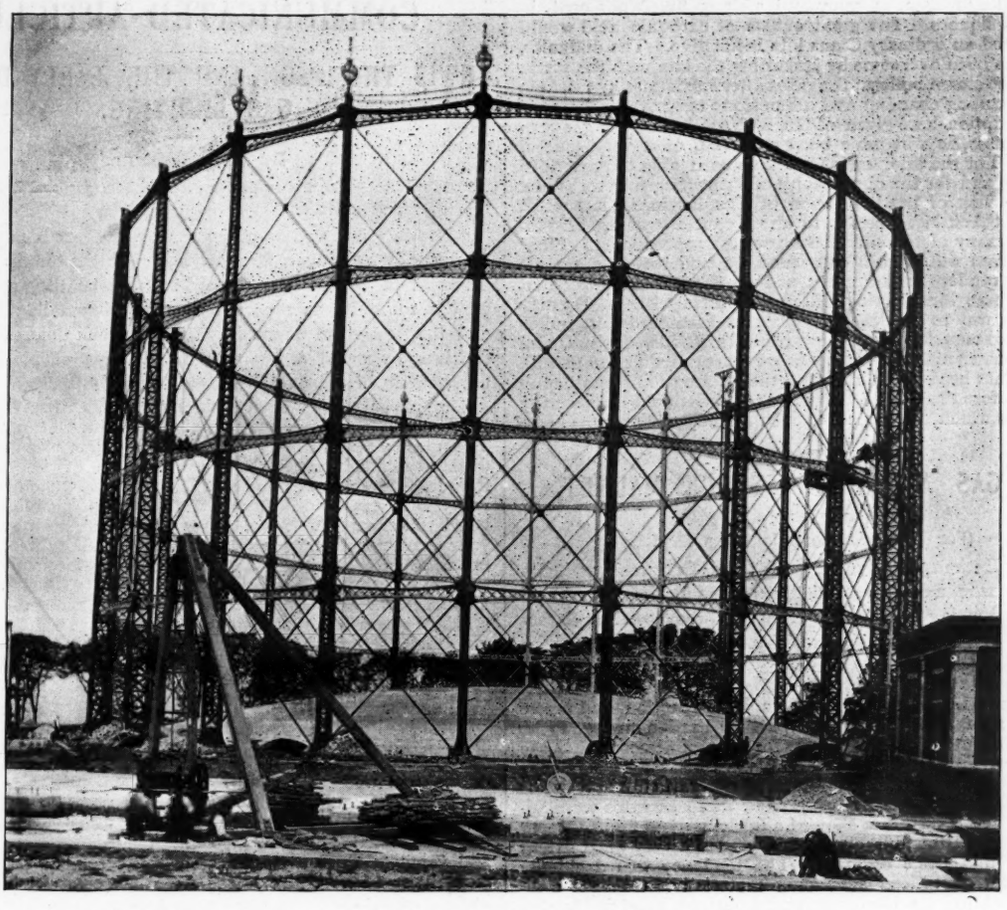
The retort-house, even in its present unfinished state, is filled with interesting features for the gas engineer; but we will not deal with them here, as Mr. Herring himself supplied ample information in the paper which he read last week before the Gas Section of the Engineering Congress in Glasgow. To render this general article complete, however, it may be said that the retort-house is an imposing structure with a circular girder roof. The house is 386 feet long inside by 100 feet clear span, and is intended to deal with 1000 tons of coal a day. It is fitted with 56 settings of nine 20-feet inclined retorts, grouped in four benches, each containing fourteen settings, with a chimney at either end of each bench, forming part of the bench, and rising to a point just clear of the ridge of the roof, so that each seven settings is served by one chimney. A few words may be added as to the feeding of the house. The coal will be received in waggons on a double line. Four waggons can tip at once on to a traversing steel belt intended to serve the coal-breakers, from the base of which the coal will be lifted by 30-inch twin elevators to the top of the retort-house, where it will be distributed on two lines of transverse conveyors, which in turn will feed four lines of longitudinal conveyors running to four storage hoppers—one over each bench. While on the subject of conveying machinery, it may be mentioned that the coke will be transferred by means of a hot-coke conveyor out of the north end of the retort-house, where it will discharge into overhead bunkers, or over screens for loading waggons direct.

The condensing arrangements consist of a duplex system—first, a sevenfold coil of pipes at the back of the haunch of the circular girder roof of the house, each bench having its own coil. From this point the gases descend and pass through the water-tube condensers, and into the exhauster-house adjoining.

An adjacent and extensive block of buildings, 500 feet long, consists of a coal-store (fitted with automatic storing appliances), with a plant-house at the south end, and a boiler-house at the north end. Pèlouze and Audouin condensers are to be fitted within the plant-house, and washer-scrubbers of the rotary type, for the extraction of ammonia as well as the cyanide products. Tubular boilers of the Stirling type are placed at the north end of this building. The steam is to be conducted by means of a 12-inch pipe to the engines in the plant-house, to the coal-breaking engines, and to the exhausters now being fixed in the adjoining building. After due consideration, it was decided that it would be more economical to convey the steam a considerable distance than to expend money on transporting the refuse fuel from the coke-yard to the south end, where the boilers would have been nearer their work, in addition to the removal of the ashes therefrom. The boilers are fitted with generator furnaces, and will be supplied with producer gas—the producer being a modification of the one used in the retort-house. The intervening space of this building, measuring 350 feet by 100 feet, is to be the coal-store for such coal as cannot be profitably stored out of doors; and its capacity is about equal to 12,500 tons. The coal is discharged from waggons at the north end of the store, in a similar manner to the discharging of the waggons to the retort-house, by means of a hydraulic ram catching the axle of the rear pair of wheels of the waggons, and lifting them—discharging the contents of the waggons from the end doors upon the traversing steel-plate conveyor feeding the coal-breaker, which is of such a character as to reduce the largest coal to moderate size. The coal-breaker will feed an inclined tray conveyor, and discharge it upon a steel-belt conveyor erected within the roof of the coal-store at a point 25 feet above the floor-line. This conveyor runs the full length of the house—viz., 400 feet. The coal can be discharged from the trays at any given point, and is intended to form itself into a conical heap throughout the length of the building—rising no higher than about 5 feet up the side walls to a point 25 feet at the centre. To remove the coal from stock, the conveyor feeding the coal-breakers at the retort-house is made to enter the coal-store; the coal at this point being fed on to the conveyor by means of a light-gauge railway and tipping-trucks.

The space between the south end of the retort-house and the coal-store is to orm the coke-yard. No special provision is being made for storing the coke in the yard, beyond a narrow-gauge railway and tipping-trucks; the present intention being to run the railways upon the coke heap, as the making of a larger percentage of breeze is of no commercial disadvantage, owing to the fact that the Commissioners are installing briquette machinery, by which they expect to realize a higher price for their coke when ground than in its natural condition. The immediate land sale and shipment will be met direct from the retort-house, by passing the coke over screens into the waggons. The removal of stock from the yard will be accomplished by means of cranes and grabs discharging over screens running upon the railway lines into waggons, both on the yard level and on the low-level railway parallel with the purifying-house.

We now come to the purifying plant, to which the gas is to be brought in two lines of 30-inch pipes. The plant consists of a double row, each of six boxes, 45 feet by 30 feet and 6 ft. 6 in. deep, with a floor above, and a light roof over the upper floor, The entire structure is of iron, consisting of cast-iron columns,



Four-Lift Gasholder (6½ Millions Capacity) at the Granton Gas-Works.

with girder floor and expanded metal concrete, supported on channel rib arches—the span of each bay being 20 feet. Some special arrangements are being introduced for discharging the purifying-boxes mechanically by air-driven motors, conveyors, &c., so as to either fill the material direct into trucks on the railway line running on either side of the boxes, or elevate it and distribute the oxide on the upper floor for revivification. In the case of lime, it is proposed to break it as it is discharged from the waggons prior to lifting it to the upper floor for slaking. Both the lime and oxide will be discharged from the upper floor into the boxes beneath by means of portable shoots.

Closely adjoining the purifying plant, a meter-house is being erected to contain four station meters, though only two are being put in at present.

A gasholder has been constructed on the extreme northern boundary of the works. The tank is 252 ft. 6 in. in diameter by 38 feet deep. The holder will be in four lifts, guided by radial and tangential rollers, and with untrussed crown. The working capacity will be 6½ million cubic feet. The external framing rises to the full height; and it is so far completed that the finials are already partly fixed. It is of a light construction, with a double system of diagonal bracing; the intermediate diagonals being circular, but of the same effective sectional area. The intermediates are brought out to an additional fixed point in the brickwork of the tank—being attached to a base fixed mid-way between the main piers—by which means twice the number of base attachments from the diagonal bracing to the masonry of the tank are secured. This is a point which we believe is novel in gasholder construction. The holder itself is finished; and the water is now being run into the tank. The outlet-pipes are 48 inches in diameter. The pumping-station for the transmission of the gas to the distributing-station nearly three miles away has been arranged in such a manner as to temporarily draw gas from the Edinburgh works to fill the new holder for the coming winter's work; and by next summer the producing plant at Granton will be ready for operation. The exhausters are in duplicate, each of a capacity of 750,000 cubic feet per hour; and they are to be driven by gas-engines with friction gear. For these engines, water-tanks are secreted at either end of the building; the intervening space being protected by a circular covered roof with glass louvres. The building is of sufficient size to enclose twice the capacity of pumping plant that is being at present installed.

Before referring to the products works, in order to complete this descriptive notice of Granton, it will not be out of place to put on record the names of the principal Contractors who have had the honour of contributing, in one way or another, to this notable work. To Mr. W. Wilson, of Glasgow, was confided the gasholder tank; to Messrs. Clayton, Son, and Co., Limited, of Leeds, the gasholder and retort-house roof; to Messrs. Redpath, Brown, and Co., of Edinburgh, the coal-store roof, the structural ironwork and floors, as well as the purifying-house; to Messrs. Summerson and Sons, of Darlington, the railways; to Messrs. Graham, Morton, and Co., of Leeds, the carbonizing plant; to Messrs. Clapham Bros., of Keighley, the water-tube condensers; to Messrs. R. Laidlaw and Son, of Glasgow, the gas exhauster, propelling exhausters, and meters; to Messrs. W. C. Holmes and Co., of Huddersfield, the Pèlouze and Audouin condensers and washer-scrubbers for both ammonia and cyanide products; to the Barrowfield Iron-Works, Limited, of Glasgow, the purifiers; to Messrs. Grice and Son, of Birmingham, the gas-engines; to Messrs. Tannett Walker and Co., of Leeds, the hydraulic machinery; to Messrs. Neill and Son, the sulphate of ammonia plant; and to the Stirling Boiler Company, of Edinburgh, the boilers. The excavations, the foundations, and the concrete work were principally carried out by the Commissioners.

This descriptive outline of the works in course of construction, may be completed by an allusion to the products works, which are situated on the lower portion of the site, adjoining the foreshore. At the present time, only the sulphate of ammonia plant is in existence. But although working, it is by no means satisfactory—many mechanical defects existing; and it has not yet been taken over from the Contractors. The plant for the production of liquid ammonia, carbonate, and nitrate and chloride of ammonia also forms part of this contract. But so much delay has taken place in the execution of the work that nothing has yet been done with this portion of the plant. Within the same building are situated the air-compressors for driving the salt-water pumps and other purposes on the upper site. They were placed here in the first instance to allow of the utilization of the air for the salt-water pumps required for the condensing appliances in connection with the sulphate of ammonia plant; the air being led in a pipe to the upper site for general purposes.

The sulphate plant consists of two stills, each capable of dealing with 90 tons of liquor per 24 hours, together with heaters and closed saturators; the saturators discharging into a centrifugal machine where the salt is dried. On dropping from the base, it is elevated and conveyed over the stone without the exercise of any labour. In order to work the plant, however, a temporary draining-tube was rigged up, in consequence of the first centrifugal machine introduced by the Contractor being altogether inefficient. Special provision has had to be made for the disposal of the waste gases from this plant, so little of the ammoniacal liquor being sulphided—not more than from 7 to 8 per cent. of

sulphuretted hydrogen, as compared with 25 to 28 per cent. in the English liquors. The great excess of carbonic acid would have rendered an ordinary Claus kiln ineffective. The difficulty, however, has been overcome by jacketting the kiln with the waste heat from the steam boilers; the gases afterwards passing through a small depositing chamber and a limestone tower.

The description here given of the first section of the gas-producing plant is, as will have been observed, of a very general character. For the information we have been able to present to our readers, and for the opportunity of inspecting the works just prior to the visit of the Institution of Gas Engineers last week, we have to thank Mr. Herring, to whose courtesy we are also indebted for many of the illustrations we are reproducing. What has been given will, we are convinced, be sufficient to make gas engineering readers desire more; and we think we may say that in time to come Mr. Herring will gratify their wishes. He may then see his way to describe the plant in greater detail, and to state his reasons for adopting various methods, designs, and forms of construction. Until then, we must remain content with the particulars here given, and with the information contained in his paper before the Gas Section of the International Engineering Congress, to which reference has been already made.

THE GAS AND WATER STOCK MARKET.

(For Stock and Share List, see p. 659.)

THE Stock Exchange had a very quiet time last week, as befits the dead season, and it was all the quieter for business being limited to a five-day run; for the Exchange was closed on Saturday. And there was no feature of particular interest, though there was enough life to produce some little tendency to fluctuation in prices. The opening showed a disposition to rise; but this was immediately succeeded by a slight reaction, and prices gave way, actuated for the most part by harder money, to be followed in quick succession by a recovery and firmer tone at the close. So when gains and losses are set against each other, they do not amount to much. In the Money Market, short loans could be had on very easy terms; but discount rates were advanced. The Gas Market showed a fairly marked improvement in point of animation; but operations were to a very great extent in Gaslight and Coke ordinary. The tendency was decidedly good, several quotations advancing materially. Gaslight ordinary marked 91½ on Monday; and from this point it steadily rose, until on the closing day it changed hands more than once at 94¼. This rise was not surprising; for we suppose it is only natural that the underwriters of the recent issue should do their best to make a good market. The secured issues were firm; and the preference, which was always a popular stock, advanced a point. Transactions in South Metropolitan were below the average; but the stock was firm, marking 126½, with a rise of a point in the quotation. In Commercials, transactions were very scarce; but there was no weakness—the debenture stock being a gainer of two points. Hardly a single bargain was marked in the Suburban and Provincial group; and in the London Market the only move was a rise in British. In the Local Exchanges, Sheffield had a considerable advance; but Newcastle, which was being quoted very high, was lowered a point. Business in the Continental Companies was of the quietest; but prices were steady, and Imperial was a point higher. The remoter undertakings were little noticed, and did not move. The Water Companies were more interesting; there being a very general advance in quotations, ranging from 2 to 4 per cent.

The daily operations were: Gas business on Monday was nearly all in Gaslight ordinary. Commercial debentures rose 2. In Water, Chelsea rose 3, Southwark 2, and ditto "D," Grand Junction, and both Lambeths 1. Tuesday's operations were the counterpart of Monday's. Gaslight ordinary rose 1. In Water, Lambeth 7⅓ per cent. rose 2. Gas business was dead-quiet on Wednesday; but Gaslight ordinary rose 1 more. In Water, Lambeth rose 2, Southwark 1, and ditto "D" 2. Thursday was another quiet day. Gaslight preference, South Metropolitan, and Imperial rose 1 each. Friday was brisker, with business mostly is Gaslight issues. British rose ⅓. In Water, West Middlesex rose 2, and Grand Junction 1. The Exchange was closed on Saturday.

Masonic.—When subscribers to the Royal Masonic Institution for Boys receive their balloting papers for the October election, they will find the name of Wilfred Algernon Burfield among the accepted candidates. This is the only son of the late Bro. F. G. Burfield, Assistant Secretary of the Tunbridge Wells Gas Company, and previously Secretary to the Gas Institute, who was initiated in the Evening Star Lodge, No. 1719, in June, 1894, and remained a subscribing member until his death in December, 1899. His widow, who suffers from an affection of the eyes, is left in such poor circumstances that the Evening Star Lodge have taken up the candidature of her child, to assist in his election into the Institution. The case is strongly recommended; and votes for any of the charities may be sent to the Secretary of the Evening Star Lodge, Bro. Walter T. Dunn, 47, Fentiman Road, London, S.W., or to the "JOURNAL" offices.

COMMUNICATED ARTICLE.

LEWIS THOMPSON AND THE EARLY DAYS OF GAS LIGHTING.

By W. J. WARNER.

"He went to Paris, and made discoveries about gas, and helped to bring it to its present perfection."

"The duty imposed upon the Newcastle Guardians of the Poor of annually hanging a floral wreath upon the tombstone of the Thompsons . . . was carried out with befitting seriousness" on the 17th ult., as reported by the "Newcastle Chronicle;" and the gentleman whose duty it was to fulfil the instructions of the testator "said a few words in praise of his intellectual attainments, his filial devotion, and his integrity."

The pages of the early volumes of the "JOURNAL OF GAS LIGHTING" bear testimony to this, the moral worth of Lewis Thompson; also to his professional courage, and to the great disinterestedness of his character. One of his most gifted friends, George Lowe, said: "I have had the honour of knowing you many years; and when you and I were schoolboys, I know you had the same high-minded feelings which have distinguished your character in riper years—the same public spirit." This was upon the occasion of the banquet in recognition of his services to gas lighting, in November, 1854. The "Chemistry of Gas Lighting" was finished the following month; and the last of his "Tables of the Illuminating Power of Gas in the Metropolis" was published the previous December. Upon the occasion of the presentation of the testimonial, there appears to have been no reference made to these tables, though this work had been of the most trying and anxious nature. The testimonial, we read, was "in acknowledgment of his indefatigable and ingenious investigations into the nature and property of coal, and the processes used in its distillation; and his disinterestedness in imparting information upon the true principle on which the manufacture of gas should be conducted."

This, though not meagre and undefined as the quotation at the head of the article, still falls short of the fulness of his important and valuable work. No doubt it was intended that the testimonial should be entirely free from all controversial and disturbing influences; that there should be no reference—or rather no direct reference—to the painful fighting past of the previous years. There should be no opportunity for a revival of the long and painful, though instructive and interesting, correspondence which had been closed some months before. The testimonial had to be placed on a higher level, above all party feeling. There could only be a full recognition of his scientific attainments, and of the generous use which he made of them to the advancement of the gas profession. For "it is," he writes, "the gas alone which interests me; and upon this point the whole of my energies shall continue to be directed with pertinacious assiduity."

Though we, professionally, are greatly indebted to him for the exercise of his scientific gifts, yet the industry is not less so. Though his science has been chiefly dwelt upon to the neglect of the consideration of his influence upon the commercial position of gas undertakings, yet this is, perhaps, not without a cause. The period of his activity was one of transition. The old companies had been attacked; new ones had been formed; and others were being projected. Great interests were at stake, as well as reputations—commercial and professional. Lewis Thompson came to the front, and in his own fearless way. "Without affectation, I may say that both schemes and companies are beneath my notice." Thus he dealt with the rival claims of rival interests. Nevertheless, both were much indebted to him; for both were put upon a sound commercial foundation by his labours. But half-a-century has now passed away, and with it the men, their contentions and rivalries. There is no fear now of disturbing these old animosities. We may therefore consider—which perhaps could not have been done before, or, at least, not well at the close of his labour in testing the illuminating power of the gases of the Metropolis—the influence of his work upon the commercial side of gas undertakings, which was such that the "testing tables" but supplement "The Chemistry of Gas Lighting;" and we may almost say this one is but the theory, the other, and the more important at the time, the practical.

The work, Lewis Thompson tells us, was commenced by taking "a small room in a small house, in a small lane in the dirtiest and most contemptible part of the City of London—unaided by anyone, doubted by all; with nothing but a trifling annuity, a steel pen, a British heart, and a strong love of truth and justice to support and assist him." This was written in May, 1853; but it was in May, 1852, that the testings were commenced. The value of this work appears to have been almost at once admitted and appreciated, not only by those deeply interested in the gas industry, but by the general public. We read in his letter of June, 1852, published in the "JOURNAL" (as all his letters upon this subject were): "The intense excitement which my humble efforts have already produced in the public mind, convinces me that the great body of the people is now fully alive to the necessity for some controlling influence over the quality. . . But, admitting the necessity for a controlling power of the kind alluded to, it

may very fairly be asked: To whom shall this power be confided? My answer is easy: To no one individual whatever. In order that the interests of honesty, truth, and justice may be served, this power like that on which our constitution is based, must rest in the hands of many." Here, then, was laid the foundation of the present system; and the self-imposed individual labours have developed into an important public service. But the immediate advantages were incalculable to the companies; the commercial position was assured, and placed upon a firm foundation. A standard of quality and purity of the article sold was set up by which its marketable or commercial value could be absolutely fixed.

Of the details of the apparatus which Lewis Thompson employed in his work, we have but little information. The then present had the advantage of the future in this respect, as he gave a general invitation to all interested to inspect the arrangements. "Those who will honour me by personally inspecting the different combinations by which absolute accuracy is here sought to be gained, will, I have every reason to believe, discover something both new and useful. . . I will now," he goes on, "say a word or two upon the illuminating standard employed, and upon the subject of condensation by bromine. The former is a spermaceti candle, or rather candles, for *three* are used." In the manufacture of these standard candles he had considerable experience, and has given interesting details in his correspondence. Of the screen, Dr. Letheby wrote at the time: "I adopted a contrivance for cutting off all diffused and reflected light; but my arrangements differed from those of Mr. Lewis Thompson. His contrivance is less cumbersome than mine."

The testings commenced with the two City Companies on April 9, 1852, and continued till May 8. The month's averages only were given of the illuminating power (120-grain candles), the condensation by bromine, and the calorific power in grains of water boiled off per cubic foot. The following month was published a daily record of observations, including the specific gravity. In August, the Chartered gas was tested. In November of the same year, the relative money values of the different gases was added to the other tables. In April, 1853, the Imperial, the London, and the Equitable Gas Companies were included in the list. Lewis Thompson wrote in July, 1853: "The table contains no statement of the specific gravity and rate of condensation of any of the gases. These particulars I intend to discontinue for the future—not that my belief in their importance is at all diminished."

The course and progress of the work, the spirit in which it was entered upon, its discouragement, and its successful close—the close of Lewis Thompson's independent personal labour, we gather from the "JOURNAL" of this period. He writes in November, 1852: "When I entered a few months ago upon an investigation of the great controversy which then agitated the City of London, I was not unprepared for some of the consequences that might possibly arise out of such an attempt. I foresaw, in fact, that my own motives, my character, my past and future career and prospects, might become subject to misapprehension and to misconstruction." These personal matters were more than realized; for in May, 1853, he writes: "The whole power of the Daily Press has now been brought to bear on (him) the 'Man in Pancras Lane'—from the very highest to the very lowest." And then: "My results in respect to the majority of the gases reported on have been gathered only with great difficulty, and at some pecuniary sacrifice, though at the same time it has gratified me exceedingly to find the public at large so completely alive to the value of my labours." Again, we read in the following September (1853): "The cause of truth and honesty, in respect to London gas, is at length triumphant, and for ever elevated beyond the reach of falsehood and interested misrepresentation. My appeal to the common sense and candour of the Directors of the Metropolitan Gas Companies has been responded to in a manner no less honourable to themselves and to me, than beneficial to the real interests of those whom they represent. Out of the thirteen Companies by whom this great capital is supplied, I have already received special permission from nine to examine, when I please and how I please, and to report upon the quality of the gas they manufacture; and, be it remembered, this permission extends to all properly qualified individuals—for such were the terms of my appeal."

Thus the end is reached; through many troubles and much anxiety, the laborious task is finished, with honour to the indefatigable experimentalist, without the least reference to his past work, to the cause of it having been undertaken, or to its successful termination, but a brief intimation only that the work would be continued—doubtless to him the greatest reward. His last letter—or rather that portion of it to which I now refer—is as follows: "In presenting my final photometrical tables to your readers, I beg to remark that the same kind of observations upon the gas supplied to the City of London will be continued by other and equally impartial hands; and the 'mantle of Elijah shall descend upon Elisha,' for the whole of my highly efficient apparatus will pass into the keeping of my successor." In his previous letter, he says: "I take my final leave, and quit, probably for ever, all connection with gas testing, making, purifying, and so forth . . . and, while reflecting in days to come upon the achievements of progressive improvement, sometimes to call to mind that there was once a 'Man in Pancras Lane.'" In this lies, if any be needed, the justification of this collaboration.

The correspondence on the "Illuminating Power of Gas in the Metropolis" commenced in May, 1852; but as "The Chemistry of Gas Lighting" had been in progress since October, 1851, the two were running concurrently. The cause which led to the one has been referred to—the City of London gas agitation; the other work was initiated by the "JOURNAL." Reference has been made to the disturbed condition of the gas industry; and probably the cause, or partial cause, of this was the condition of the manufacture. This was very boldly commented upon at the time by the "JOURNAL," though it was but then in its infancy as to age (only in its third year). But its management was vigorous and enterprising. The "Circular to Gas Companies" of September, 1851, contains the following: "It is impossible to conceal the fact that gas making has not progressed during the last twenty years in the same ratio as other manufactures of its class. It is still the same coke and gas making, waste-product neglecting, business that it was a quarter of a century ago." Fifty years ago to this day—Sept. 10, 1851—the "Circular" of the "JOURNAL" set forth arrangements which had been made for an inquiry into this matter of "waste products," and "of reviewing from beginning to end the whole process of gas making," having secured "the co-operation of a body of gentlemen remarkable for their scientific knowledge on this subject." Thus commenced "The Chemistry of Gas Lighting." But the whole passage of the "Circular," I feel assured, will be read with much interest and satisfaction. I therefore give the full text:—

> We have assigned to ourselves the task of inquiring into and elucidating this question of waste products, though not without a full conviction of the difficulties inseparable from so complex an investigation. Nevertheless, having the good fortune to secure the co-operation of a body of gentlemen remarkable alike for scientific and practical knowledge on this subject, we cheerfully commence our labour of reviewing from beginning to end the whole process of gas making, and shall each month publish our experimental results in the order in which they arise. Analytical investigations will be made upon the different kinds of coal, coke, lime, gas lime, ammoniacal liquor, tar, and coal gas, both pure and impure; and the modes of analysis pursued in each instance given in plain and simple language, so as to form a kind of gas engineer's *vade mecum*. The various products arising from the ashes of coal, the compounds of cyanogen contained in impure gas and gas liquor, the different modes of working up ammoniacal salts, and the materials best adapted to arrest and condense ammonia, will all be treated of in a practical and intelligible manner, and with strict reference to the economical principles of proper manufacture. . . . That *vexata questio*, the illuminating power of coal gas will also occupy no inconsiderable share of attention.

Thus we again see the supplementary character of the correspondence on the illuminating power of the Metropolitan gases.

The work was commenced the following month, and was continued through the volumes of the "JOURNAL" up to the end of 1854. In the first issue of the year 1855, there is an address by the Editor, who "with pride points to the series of articles on 'The Chemistry of Gas Lighting,' as contributions worthy of the highest rank in the scientific annals of the country."

It is impossible to close this article without just a brief note of admiration for the energy and enterprise of the founder of the "JOURNAL" and its gifted Editor—the late Thomas G. Barlow—"who," it was said at the presentation of the Thompson testimonial, "had been mainly instrumental in giving to the world the development of the valuable researches of their friend Mr. Thompson, at great trouble and expense, in a journal devoted to gas interests."

PERSONAL.

Mr. G. LYNCH, Chairman of the Cork Gas Consumers' Company, has been appointed to a similar position in the Waterford Gas Company, in succession to Mr. W. H. Shaw, deceased.

Mr. JAMES GLAISHER, F.R.S., who was for nearly thirty years Chairman of the Harrow and Stanmore Gas Company, has resigned his seat on the Board, and Mr. ARTHUR F. PHILLIPS, M.Inst.C.E., has been appointed a Director to fill the vacancy.

Mr. ARTHUR BOND has been appointed, out of 42 applicants, to fill the position of Manager of the Aberavon Gas-Works, in succession to Mr. Walter Lister, resigned. Mr. Bond holds a first-class certificate in "Gas Manufacture;" and he has been in charge of the works for some time.

At the Eccles Congregational Church, last Thursday, the marriage was solemnized, in the presence of a large gathering of friends, of Miss HELEN SMALL RUSSELL, eldest daughter of Mr. A. C. Russell (of Messrs. Fletcher, Russell, and Co., Limited), and Mr. HENRY LEAKE MORLEY, only son of Mr. Henry Morley, M.Inst.C.E., Engineer and Manager of the Cardiff Gas Company, to whom he is Assistant Works Manager.

After a service extending over forty years, Mr. W. A. RICHARDSON, M.Inst.C.E., the Water Engineer of the Birkenhead Corporation, finds himself, owing to failing health, unequal to the duties which the position entails. He has therefore been relieved of them, and has been appointed Consulting Engineer. Mr. Richardson is President of the British Association of Water-Works Engineers; and it may be remembered that, at the meeting of the Association at Birkenhead, in July, he had to explain that, owing to recent indisposition, he had not been able to prepare so adequate an address as he could have wished. The resignation was brought before the Town Council last Wednesday, in the minutes of the Gas and Water Committee.

CORRESPONDENCE.

[We are not responsible for opinions expressed by correspondents.]

Professor Lewes's Experiments at the Crystal Palace Gas-Works.

SIR,—The importance of the experiments made at the Crystal Palace Gas-Works, and discussed at the recent Gas Congress, is so great that I should like to point out a few facts that they appear to teach.

1.—That the best results *in proportion to water gas admitted*, were obtained by continuing for a period of four hours during the charge (see Table I., column 4), and the worst for a period of two hours (see Table I., column 8).

2.—That the best time for admitting the water gas was immediately after the charge of coal.

3.—That the best proportion of water gas to coal gas to be added *per hour* is 12½ to 15 per cent.

If any further experiments are undertaken, it appears desirable that the following data should be recorded, in addition to the volume, temperature, and pressure of the several gases :—

1.—For the coal gas distillation—

(*a*) The temperature of the retort, as recorded by Callender's pyrometer.

(*b*) The calorific value and flame temperature of the gas at each hour of the experiment.

(*c*) The illuminating power with the table photometer and also with a 3-inch flame, separately, each hour.

(*d*) The percentage of NH_3, CO_2, CO, and H each hour in the gas at the inlet of the condensers.

2.—For the water gas—

(*a*) The temperature on admission to the retort.

(*b*) The calorific value and flame temperature.

(*c*) The percentage of NH_3, CO_2, CO, and H therein.

3.—For the mixed gas, the same as for coal gas only.

As the tests of the heating factors can be ascertained with such greater exactitude than illuminating power, and as they are of increasing importance as to incandescent lighting, they should, I venture to suggest, be accorded a leading place in future investigations.

Halifax, Sept. 7, 1901. THOS. HOLGATE.

The Board of Trade and Electrolysis.

SIR,—It will perhaps be in the recollection of your readers that the Wakefield Gas Company recently appeared before the Board of Trade to obtain the insertion of a clause in the Wakefield and District Light Railway Order for the protection of their mains against electrolysis. Our Solicitors have received the following communication from the Board with reference to our application:—

Board of Trade (Railway Department),
7, Whitehall Gardens, S.W., Aug. 13, 1901.

WAKEFIELD AND DISTRICT LIGHT RAILWAY ORDER.

Messrs. Stewart and Chalker, Wakefield.

Gentlemen,—With reference to your objections on behalf of the Wakefield Gaslight Company to the confirmation of the above-named Order, I am directed by the Board of Trade to state that, after carefully considering the circumstances of the case, and the balance of parliamentary precedents in the matter, they have come to the conclusion that sufficient cause has not been made out for the proposed amendment put forward by the Gas Company.

(Signed) HERBERT JEKYLL.

From this it is evident that gas undertakings must not look to the Board of Trade to lead Parliament in this matter.

Gas-Works, Wakefield, Sept. 1, 1901. H. TOWNSEND.

Auditing of Gas Companies' Accounts.

SIR,—I agree entirely with Mr. George Helps that the manager of a gas company must have responsibility for the correctness of the books—that is to say, must be held responsible for seeing that the system upon which the books are first made up, and then examined by officers other than those concerned in their compilation, is such that the risk of fraud is reduced to a minimum. I agree that no cashier or collector should ever be allowed to make an entry in a ledger of cash received by him; I would go further, and say that he should not be permitted to make any entry in the ledger the accounts in which he may have to receive. I agree that if the manager of a gas company takes a real interest in the accountant's department, no auditor should be able to teach him anything connected with the work of the department. I agree that efficient auditing would not do away with the necessity of a proper system of accounts. But what have any of the points on which I am in agreement with Mr. Helps to do with the responsibility of the auditor?

The manager is responsible to the directors for the correctness of the accounts laid before them; but the whole object of the appointment by the shareholders of auditors responsible only to them, is to provide means whereby the shareholders may be protected against the dishonesty of the directors, the manager, or any of his staff. That being so, the acceptance of any amount of responsibility by the manager cannot relieve the auditors of any jot or tittle of theirs. It is their principal business to guard against fraud perpetrated with the knowledge, sanction, and at the instigation, of those in the highest positions of responsibility. I never said it was their business "to control the works."

Three cases have been commented upon in recent times as illustrative of the absurd inadequacy of the present methods of auditing—those of the Millwall Dock Company, the National Bank of Wales, and Dumbell's Bank. In the first case, it was the Managing Director (and former Manager) who was convicted of fraudulent manipulation of the accounts; in the second, the Chairman and the Managing Director were convicted of that offence; and in the third, a Director and a Manager. The managers in all these cases knew all about, and were quite willing to accept responsibility for, the accountant's department. Yet Mr. Helps asks: "Would not the case be met if auditors remained in their present positions, and engineers and managers took more interest in the commercial or accountant's side of their undertakings?"

It cannot be said too plainly that the present position of auditors is too often somewhat akin to that of persons obtaining money under false pretences. They certify accounts as "correct" when there are few entries in them which they have verified in any but the most superficial and worthless manner. They accept the certificates of the men against whose possible dishonesty they are appointed to safeguard the shareholders, as sufficient warrant for the correctness of material items in the balance-sheet. Then they draw their fees, and hope for the best.

I have been told that the task I would impose upon the auditors of a big industrial concern is too vast for them to undertake—that no auditor, in fact, would undertake it. My answer is twofold. The remuneration must be made adequate. Then, if no auditor would accept the post, the shareholders would be no worse off than they are at present—would, indeed, save the money they now spend on a farce that affords considerable amusement to those who are best, and deceives those who are least, able to understand the value of it. Moreover, shareholders would then know that they were, as in fact they now are, dependent entirely upon the honesty of their staff. That, in the case of the gas industry, they run little risk in so doing, has nothing to do with the case. The name of Higgs may remind some people that there is some risk, even with gas companies. Auditing being a farce, should be either ended or mended.

Sept. 7, 1901. F. G. NEWTON.

LEGAL INTELLIGENCE.

Leaving Work without Notice.

At the Sussex County Sessions at Hastings, a few days ago, George Barker was summoned by the Bexhill Gas Company in respect of two weeks' wages, at 28s. per week, in lieu of notice. Mr. H. G. Stapylton-Smith represented the Gas Company. Mr. Fred Russell, the Engineer and Manager, stated that defendant had been engaged as a stoker, and that in the summer he had been working at 24s. a week for six days, instead of 28s. a week for seven; but that when he left he was again working for seven days, at 28s. a week. He left without notice, and went to another situation at Crowborough. Defendant contended that the fresh arrangement at 24s. a week vitiated the old one. The foreman at the gas-works gave evidence as to the alteration of wages in the summer being a recognized thing. Defendant made no objection, and said nothing about any fresh agreement. He was put back into the retort-house just before he quitted the place. When he left, he said he wanted to see his sister in London. Witness had since ascertained that he had obtained another situation. On the suggestion of the Magistrates' Clerk, Mr. Stapylton-Smith expressed his readiness to accept one week's instead of two weeks' wages. It was a matter of principle; and the fact of defendant leaving without notice put the Company to inconvenience. Defendant was ordered to pay a week's wages (24s.) as damages and the costs of the summons (3s.); and he was allowed a fortnight in which to do it.

Unlawfully Connecting a Gas-Stove.

At the Wallasey Petty Sessions last Wednesday, Henry Cookson, master mariner, and his wife, of 39, Seaview Road, Liscard, were summoned for causing a pipe to be connected with the gas-mains without the consent of the Wallasey District Council, and also for improperly using gas, the property of the Council. Joseph Croxford, a plumber, was also summoned for causing the pipe to be laid. The defence was that the pipe was by a pure mistake connected to the gas-stove, and as it caused the wall to sweat, it was removed within about a week. There was not the slightest intention to defraud, and Mrs. Cookson quite understood that the plumber was fixing the connection to their own pipes, and not to the main. The Bench considered that Mr. and Mrs. Cookson were not to blame, and that justice would be met by their paying the costs—3s. 6d. each. Croxford, whose workman fixed the pipe, and who expressed his willingness to pay for whatever gas might have been used, was fined 2s. 6d., and 8s. 6d. costs.

Long Eaton District Council and the Gas-Works.—At the meeting of the Long Eaton District Council on Monday last week—Mr. George Smith, J.P., presiding—the Deputy-Clerk (Mr. James Brooks) read a letter from the Gas Company, stating that they gathered from reports that the Council declined to appoint an expert as agreed between them and the last deputation; and as there appeared to be little chance of the Council ever being in a position to treat with the Company on a proper basis, the Directors assumed the negotiations were now at an end. Though not anxious to sell the undertaking, they were willing to save the necessarily heavy expense of arbitration by both parties having an expert to assess the value. The Chairman asked whether or not the Council would appoint a valuer. It was decided to proceed with the next business, and the matter remains in abeyance.

Abandonment of the Portsmouth Water-Works Purchase Scheme.—The proposed purchase of the Portsmouth Water-Works by the Corporation having evoked so much adverse criticism by the ratepayers of the borough, the Committee having charge of the negotiations have decided that, under present conditions, it would be inadvisable to proceed further in the matter just now; and they have accordingly decided to drop the scheme. The decision, which, we learn from a local paper, was arrived at at a meeting of the Committee last Wednesday, was somewhat unexpected, coming so early; although in face of the opposition by the ratepayers, it was not altogether unlooked for. The supporters of the scheme nevertheless still believe that the terms of purchase were favourable from the ratepayers' point of view.

MISCELLANEOUS NEWS.

GAS AND WATER ORDERS OF LAST SESSION.

The report of the Board of Trade on their proceedings under the Gas and Water Works Facilities Act, 1870, during the past session has been issued. It states that in December, 1900, twenty-one applications for Provisional Orders were made to the Board—nine related to gas, and eleven to water undertakings, and one to a water and gas undertaking. The amount of capital proposed to be authorized was £946,000 by shares and £264,916 by loan; and of the total amount (£1,210,916) £431,000 share and £111,166 loan capital was for gas, and £415,000 share and £128,750 loan capital for water purposes. The remainder—viz., £100,000 share and £25,000 loan capital—was required for the one water and gas undertaking.

The applications for Gas Orders were in regard to Caterham and the district, High Wycombe, Horsham, Nuneaton, Pinner, Portsea, Slough, Swaffham, and Woking. Eight applications—viz., those relating to Caterham and the district, High Wycombe, Horsham, Nuneaton, Pinner, Portsea, Slough, and Woking—were in respect of undertakings already authorized by Provisional Orders, and sought the following powers: The Caterham and District Gas Company, Limited, to construct additional works for the storage of gas, and to extend their limits of supply; the High Wycombe Gas Company, Limited, to raise more capital and extend their limits of supply; the Horsham Gas Company, Limited, to maintain and continue additional works for the manufacture and storage of gas; the Nuneaton Gas Company, to construct additional works for both manufacture and storage, and to raise further capital; the Pinner and Portsea Island Gas Companies, to construct additional works for the manufacture and storage of gas, and to raise further capital; the Slough Gas and Coke Company, to raise more capital and to convert the existing ordinary capital of the Company; and the Woking District Gas Company, Limited, to raise additional capital. One application—relating to Swaffham Gas—was in respect of an unauthorized gas undertaking; and the proprietors sought power to maintain and continue existing gas-works, and to manufacture and supply gas.

Objections were lodged against several of the applications; and they were fully considered by the Board of Trade—local inquiries being held in four cases. Orders were granted in every instance, except in the case of the Caterham Company's application, subject to certain modifications and amendments. That Company failed to obtain the consents of some of the Local and Road Authorities concerned; and numerous objections were lodged against the application. The promoters having asked the Board of Trade to dispense with the consents of the opposing authorities, under the powers conferred upon them by section 4 of the Gas and Water Works Facilities Act, 1870, the Department appointed Mr. Ingram B. Walker to hold a local inquiry, and to report to them in the matter.* Upon his report, they decided not to proceed with the Order.

In the case of the Horsham application, the promoters asked the Board to dispense with the consent of the Horsham Urban District Council, which they were unable to obtain. A large number of objections were also lodged against the application. The Board thereupon appointed Mr. Walker to hold a local inquiry,† and upon his report decided to dispense with the consent of the Urban District Council, and to grant an Order, subject to certain modifications and amendments. The Board made a special report to Parliament on the matter, in accordance with the terms of the Gas and Water Works Facilities Act, in the course of which they said:—

> As the result of the inquiry, the Commissioner reported that he saw no reason for refusing to accept the plea of the promoters that the additional works had been erected by inadvertence on an unauthorized site; that to meet the demand for gas the Company must increase their producing plant; and that if the Company were obliged to reconstruct the additional works on a portion of the already authorized site, the community as a whole would not gain. He therefore recommended that, in the circumstances, an Order should be granted, but that the use of a portion only of the proposed new site should be sanctioned. After considering Mr. Walker's report, the Board of Trade decided to grant an Order, subject to the suggested restriction of the new site, and to certain other modifications and amendments.

In the case of the Nuneaton application, objections were lodged by the Nuneaton and Chilvers Coton Urban District Council and by several owners and occupiers of houses in the vicinity of the proposed works. The promoters asked the Board to dispense with the consent of the Urban District Council, and the Board directed a local inquiry to be held by Mr. Walker. It appeared from his report that one of the two scheduled sites had been abandoned by the promoters, and that the Council had withdrawn their objection to the application on an undertaking being given that no works for the manufacture of gas would be constructed on the new site for seven years, and that during this period the Council should have the option of purchasing the Company's undertaking. Mr. Walker recommended that the application should be granted, and the Board made an Order, but limited the additional works to be erected on the new site to storage purposes only.

In the case of the Pinner application, several objections were lodged with the Department, and the consent of the Pinner Parish Council was refused. The promoters asked the Board to dispense with this consent; and Mr. Walker was appointed to hold a local inquiry into the application‡. Upon consideration of his report, the Board decided to dispense with the consent of the Parish Council and to grant an Order; and they presented the usual special report to Parliament on the subject, setting forth their reasons for so doing.

In the following Orders, a maximum price per 1000 cubic feet of gas was fixed; power being reserved to the Board, after three years, to alter it, or to substitute a sliding-scale: Horsham, 4s. 7d.; Pinner, 5s. 2d.; Swaffham, 5s. 6d. The sale of gas in bulk beyond the area of supply was authorized, subject to the usual limitations, in the Nuneaton, Pinner, and Swaffham Orders. The first and last named Orders contained agreed clauses as to the purchase of the undertakings by the Nuneaton and Chilvers Coton Urban District Council and the Swaffham Urban District Council respectively.

The applications for Water Orders were in respect of Bearsted, the Dearne Valley, the Frimley and Farnborough District, Henley-on-Thames, Hungerford, Mid-Kent, Perranporth, Slough, South Staffordshire, the Tilehurst and Pangbourne district, and the Wokingham district. The Dearne Valley, Frimley and Farnborough, South Staffordshire, and Wokingham applications were for additional capital in respect of existing undertakings; the Henley-on-Thames and Slough applications, for extensions of the limits of supply and for additional capital; and in two cases—Mid-Kent and the Tilehurst and Pangbourne district—power was sought to extend the existing limits of supply, but no additional capital was asked for. Three applications—Bearsted, Hungerford, and Perranporth—were in respect of new undertakings, and power was sought to construct and maintain water-works and supply water. Objections which were lodged against several of the applications were fully considered by the Board, and Provisional Orders were granted in every instance, subject to certain modifications and amendments. The promoters of the Bearsted Order subsequently decided not to proceed further, and did not, therefore, advertise the Order, as required by the Act.

The only application in regard to water and gas was made by the Bexhill Water and Gas Company, who applied for power to raise additional capital. No objections were received, and a Provisional Order was granted.

The Orders were submitted for confirmation by Parliament in four Bills—viz., the Gas and Water Orders Confirmation Bill, the Gas Orders Confirmation Bill, and the Water Orders Confirmation Bills (Nos. 1 and 2)—which were introduced into the House of Lords; the three first named on the 29th of April, and the last on the 3rd of May. A petition was lodged against the Water Orders Confirmation (No. 1) Bill by the Kingswinford Rural District Council, in respect of the South Staffordshire Order; but the Select Committee to whom the Bill was referred passed the Order without amendment. No opposition was offered to the remaining Orders; and the Bills passed through the various stages, and received the Royal Assent on the 26th of July.

The number of Orders applied for since the passing of the Gas and Water Works Facilities Act, 1870, is 541; and the Board of Trade have made 500, of which 489 have been confirmed by Parliament.

* See "JOURNAL," Vol. LXXVII., p. 832. † *Ibid., loc. cit.*
‡ *Ibid.*, Vol. LXXVII., p. 895.

SOUTH METROPOLITAN WORKMAN-DIRECTORS.

The New Scheme as Approved by the Board of Trade.

In the last number of the "JOURNAL," it was briefly intimated that the scheme prepared by the Directors of the South Metropolitan Gas Company, and adopted at the recent special general meeting, for enabling the employees holding ordinary stock to elect one or more of their number to the directorate, had been approved by the Board of Trade and published in the "London Gazette." We now give the principal portions of the scheme, which the Directors were authorized to prepare by section 19 of the Company's Act of 1896. It was therein specified that the qualification of a workman-director should be seven years' constant service and the holding, for not less than twelve months prior to his election, of ordinary stock of the nominal value of not less than £250. By an Act passed in the following year, however, the qualification was reduced to £100. The following is the text of the scheme as passed by the Directors on the 7th, and approved by the Board of Trade on the 24th ult.:—

This scheme shall come into operation as soon as it has been adopted by the shareholders of the Company, in manner provided by the South Metropolitan Gas Act, 1896, and approved by the Board of Trade, and shall continue in force for nine years, subject to cesser if the amount of the investment of the employees in the stock of the Company shall fall below the nominal amount of £40,000, or if the shareholders as herein provided shall determine that its continuance is not advantageous to the Company.

At the August half-yearly general meeting in 1904, and again in August, 1907, the Directors shall specially report to the shareholders on the working of the scheme; and should the report, in the opinion of the shareholders, be unsatisfactory, and the system detrimental to the interests of the Company, the shareholders shall, at the end of each three years, have power to terminate the scheme by giving six months' notice. Such notice shall be given at the August meeting that at the half-yearly meeting in the following February a resolution will be submitted for that purpose. Notice of such proposed resolution shall be sent to every shareholder with the February report, and proxies shall be sent therewith. A majority of votes, in person or by proxy, shall determine the issue.

The number of employee Directors shall not exceed three, of whom one shall be a salaried officer, and the other two employees in receipt of weekly wages.

Every employee shall have for this purpose one vote for every £10 of stock held in his own name, or jointly with that of his wife or child, up to £100, ten votes; one vote for every £25 above the first £100 up to £300, eight additional votes; one vote for every £50 above the first £300 up to £1000, 14 additional votes; above £1000 no more votes—thus giving a maximum of 32 votes. The qualification of an employee Director shall be the having been not less than seven years in, and continuing in, the employ of the Company, and the having held for not less than twelve months prior to the date of election, and the continuing to hold, not less than £100 in the stock of the Company.

The Company shall, one calendar month at least prior to the date of election, make out an alphabetical list of all the employees possessing the necessary qualification to act as Directors; giving the name of the station at which each is employed, his length of service, and his occupation. Such list shall be printed and posted up for seven days in conspicuous places at the various offices, works, or stations of the Company, and shall be supplied to any shareholding employee on

application at the head office or the office of his station. Any qualified employee not wishing to be a candidate can have his name withdrawn by writing to the Secretary to that effect within eight days from the posting up of the list; and his name shall forthwith be struck out of the posted lists.

For the purpose of this scheme, the three smaller stations shall be grouped together. Thus, in the selection of candidates, the Bankside, Greenwich, and Rotherhithe stations shall be entitled between them to select one candidate, and Vauxhall, East Greenwich, and Old Kent Road, and the salaried officers shall each be entitled to select one candidate; but no station shall at any time have more than one employee Director on the Board.

For the selection of candidates, every voter at each station, except the station or stations at which the Director or Directors remaining upon the Board are employed, shall be supplied with a voting-paper in the form prescribed in the Schedule A attached hereto. Such voting-paper shall be addressed personally to each voter, and shall contain the names of all the employees at the station who are qualified and willing to act as Directors. The salaried officers of the Company may, at the discretion of the Board, either make their selection and vote separately from the workmen, or officers and workmen may unite in the voting; but, in accordance with the last sentence in the preceding section, the officers cannot select a candidate from the employees of any station that at the time has a Director remaining on the Board. If he desires to record his vote, he shall place his full number of votes, as set out on the voting-paper, against the name of any one candidate (or two candidates if there are two vacancies) whom he thinks best fitted to become a Director, sign the paper, and hand it to the persons—viz., one officer nominated by the Board, and the last elected workman member of the Profit-Sharing Committee—who shall be appointed to receive it. In the event of any candidate receiving a majority of the total number of votes polled at his station, he shall be the selected candidate for that station: but should this not be the case, new voting-papers shall be issued containing the names of the two candidates who received the highest numbers of votes. A second vote shall, in that event, be taken; and the candidate who receives the highest number of votes shall then be the selected candidate for that station.

When this selection has been made, another voting-paper (Schedule B), containing the names of all the selected candidates of the several stations, shall, unless the Directors decide that the officers shall vote separately, be supplied to every voter at all the stations. Voters must put the full number of their votes against the name of any candidate —or of two names, if two Directors are to be elected—or their voting papers will be spoilt and their votes lost.

One Director elected under this or the preceding scheme shall retire after the first Board meeting in the month of November every year. If duly qualified, the retiring Director shall be eligible for re-election. The retirement shall be by rotation.

All elections, except in the case of unexpected vacancies, shall take place between the 1st of September and the 1st of November in each year, on a date to be fixed by the Board. Employee Directors whose turn it is to retire shall continue to serve until their successors are appointed and take office. In the event of retirement at other than the usual time, by leaving the service of the Company, or the death of an employee Director, a successor shall be elected within two months, at a date to be fixed by the Board, who shall take the place and retire in the turn of the late Director.

The employee Directors shall have their ordinary duties, and the pay attaching thereto, suspended during the time that is found to be necessary for their duties as Directors. The fees for their service as Directors shall be the amount they would have earned if they had been at their ordinary employment, *plus* £1 1s. for each attendance.

THE PRICE OF GAS IN LONDON.

The Annual Meeting of the Gas Consumers' Protection League (Clubs and Societies Branch) was held last Thursday at the Mildmay Radical Club, Newington Green, N.—Mr. F. S. W. Pettengell (Vice-Chairman of the Metropolitan Radical Federation) presiding. The Committee, in their annual report, regretted that more support had not been forthcoming, and that their labours had not been crowned with success in the reduction of the price of gas. The withdrawal of the Gaslight and Coke Company's Bill on its second reading was a signal success; and had London gas consumers been thoroughly organized, it must have been the beacon-light of a complete triumph for justice to the consumers. Apathy carried with it failure; and the half-hearted efforts of the Borough Councils in regard to the South Metropolitan Gas Bill would, in the immediate future, prove a bad policy. The report was adopted. The Chairman said the question before the meeting was one that was of interest to all classes. It was, he considered, ridiculous that the Gas Company on the north of the Thames should have charged 9d. per 1000 cubic feet more than was paid on the south. He did not think they were going to have any reduction. The Gaslight and Coke Company had intimated that, in the event of the price of coals not being raised, they would reduce the price to the consumers next January. But, unfortunately, a rise in the price of coal took place on the previous Monday, and they could not, therefore, hope for much improvement. Mr. James Rowlands moved a resolution to the effect that the meeting strongly protested against the exorbitant charge of 3s. 5d. per 1000 cubic feet, and 4s. 2d. to the users of slot meters. This, in comparison with the charges of the other Companies supplying the Metropolis, was totally unjustifiable. The meeting was, therefore, of opinion that further active steps should be taken to prevent the Company obtaining any additional parliamentary powers until the management of the Company had been thoroughly reformed. Mr. Rowlands considered that there should be a drastic reform in the administration of the Company. They were now in a position, if they pleased, to bring the Company to their knees. He could not understand why the price of gas should be so much greater in North London than elsewhere. He hoped that this movement was going to make more rapid strides, and that every effort would be made to see that the gas consumers were treated with all fairness. The motion was carried.

PROVINCIAL GAS AND WATER COMPANIES.

Gas Companies.

The 91st half-yearly meeting of the Farnworth and Kearsley Gas Company was held on the 29th ult. The Chairman (Mr. J. W. Watkinson) stated that the profits made during the six months ending June 30 amounted to £703, which, with the balance brought forward, made the amount available for distribution £2611. As they had anticipated, the profit fell short of the amount required to pay the usual dividend, due to the increased cost of coal and cannel. Owing to the accumulated reserve, however, the usual dividends of 10 and 7 per cent. could be recommended. Notwithstanding the advance in the price of coal, &c., they had not raised the price of gas, thinking the accumulated reserve rendered it unnecessary. There was an increase in both ordinary and penny-in-the-slot customers. He moved the adoption of the report; and the motion was carried.

The accounts of the Leamington Priors Gas Company for the six months ending the 30th of June show that the sale of gas produced £26,951; residuals and fittings yielded £9510; and the total revenue (including a balance of £9983 brought forward) was £46,802. The expenditure was £36,732, including £20,126 for coals; leaving a balance of £10,070 applicable to the payment of dividends.

The half-yearly general meeting of the Lewes Gas Company was held last Wednesday—Alderman Kemp in the chair. The Directors reported a profit of £1435 on the revenue account in the six months ending June 30; and a balance of £3255 on the profit and loss account available for distribution. They recommended that dividends be declared for the half year of 5 per cent. upon the original, and 3½ per cent. upon the additional capital. These, after deduction of income-tax, would amount to £1403, and leave a balance of £1852 to be carried forward. In moving the adoption of the report, the Chairman said the Company had never, so far as he knew, sent out so much gas in a half year as they had done during the past six months. This was largely due to extra business in cookers and prepayment meters; and he thought from these two sources they might look for more in the future. The larger the output of gas, the cheaper could it be manufactured; and as Lewes was not a very growing place, it was satisfactory to find that, so far, they were increasing the quantity of gas supplied. They had now the electric light in the town; but the Gas Company would endeavour to maintain an attitude of friendliness with all they came in contact with, whether as competitors or otherwise. The Directors would, no doubt, in the future, as in the past, study the interests of the shareholders; and one way—indeed, the principal way—of doing so was for them to study the interest and the convenience of the consumers. Alderman Farncombe, in seconding the motion, said he fully endorsed the Chairman's remarks, with reference to the conduct of the Company. Undoubtedly the consumers required to be considered as well as the shareholders—in fact, now that they had the competition—he was pleased to find it was friendly—of the electric light, he trusted the consumers would be considered, even if it were a question of reducing the dividend. The report was adopted, and the dividends recommended were declared.

At the recent half-yearly meeting of the Normanton Gas Company, the report presented showed that the profits for the six months ending June 30 amounted to £1045. The amount available for distribution, after providing interest on mortgages, was £2732, out of which the Directors recommended the payment of dividends of 5½ per cent. on the original, and 4 per cent. on the additional stock. The Chairman (Mr. E. Mitchell, J.P.) moved the adoption of the report, and said the Directors considered it to be of a fairly satisfactory character, especially taking into account the adverse conditions which had prevailed, such as the high price of coal and materials. The total expenses were £2974, or an increase of £567; but as the rise in the cost of coal was £547, this practically accounted for it. While many gas companies were showing a reduced income from the sale of gas, they at Normanton had had an increase of £216 for the half year, and the revenue from slot meters had gone up from £403 to £502. Residuals had dropped considerably; but altogether there was a net increase of £112. The total income was £4020—an advance of £369; and the profit, £1045, was a decrease of £198. After payment of the dividends, there would be a balance to carry forward of £1552. Mr. Armitage seconded the motion, and it was carried; and the dividends recommended were declared.

At the recent annual general meeting of the Ryde Gas Company, the accounts presented showed that the receipts from the sale of gas amounted to £11,838; residuals produced £4915; and the total revenue was £17,129. The expenditure on the manufacture of gas was £10,939; on distribution, £567; and on management, £902—the total expenses being £13,424. The balance carried to the profit and loss account was £3705, and the amount available for distribution was £1966; but £589 was drawn from the reserve fund to make up the dividend paid in March. The Directors recommended the payment of the maximum dividend. In their report, the Directors stated that the number of cookers sent out by the Company during the twelve months was largely in excess of that of any previous similar period.

The half-yearly meeting of the Sevenoaks Gas Company was held a few days ago, under the presidency of Mr. W. Cronk. The report presented showed that the gross receipts in the six months ending June 30 last were £8382, while the expenditure was £6771; leaving a profit of £1611. Adding the balance brought forward produced a sum of £4775 available for distribution. The Directors recommended the declaration of the usual dividends. In moving the adoption of the report, the Chairman said he thought the shareholders would all agree with him that both it and the accounts were very satisfactory, especially when they took into consideration the high prices which they had to pay for coal, added to the fact that the amount realized for residual products was not so high in proportion as the first cost of coal would have led them to expect. This was probably largely due to the mild winter; and he considered, bearing those things in mind, they might congratulate themselves on the good progress made by the Company. The works (under the supervision of Mr. W. J. Dougall) were in a satisfactory condition; and arrangements were being made for putting up three additional beds of retorts. They were about to sink a well

which would supply the works with water at a saving of £30 to £40 per annum. The report was adopted.

The annual general meeting of the Sunderland Gas Company was held last Wednesday—Mr. S. P. Austin presiding, in the absence, through illness, of the Chairman (Mr. J. Stokoe). In moving the adoption of the report, noticed last week, the Chairman said there had been a decrease of £2039 on the cost of repairs of works, mains, and meters, and, compared with the previous year, a total decrease of £2201. The chief increases were as follow: Wages, £1727; coals (984 tons more), £28,703; water-rents, £110; salaries, £116; and law costs, £120. The total was £30,821. On the other side of the account, the increases in the revenue were: Gas and meter rentals, £20,404; and from the sale of residuals, £9855. There was an additional net revenue of £30,260. It had been necessary to raise the price of gas, owing to the higher cost of coal, in order to maintain a fair working return for the shareholders. The result was that, while they had to entrench to a small extent on the reserve fund in order to maintain the dividend last year, they were able now not only to reduce the price to consumers, but to maintain the usual dividend. The Directors had naturally had an anxious time, on account of the increased price of coal, and the difficulty of getting it of good quality; but, assisted by their very able Manager and Secretary (Mr. J. H. Cox), they were able to follow a course which seemed to have met with the approval not only of the shareholders, but of the private consumers. The report was adopted, and dividends were declared of 5 per cent on the original stock, and 4½ per cent. on the additional capital stock for the six months ending June 30, less income-tax.

The annual meeting of the New Swindon Gas Company took place a few days ago. Mr. W. H. Ludgate (the Chairman), in moving the adoption of the report, congratulated the shareholders upon the fact that, notwithstanding an increase of about £1600 in the cost of coal, they were able to declare the usual dividends without raising the price of gas or drawing upon the reserve fund. During the year they had sold 80 million cubic feet of gas—an increase of 9 millions as compared with the previous year. Of this quantity, penny-in-the-slot meters were responsible for 6 millions; making the total slot meter consumption at present 25 millions. The amount received for gas during the year was £14,800; being £1700 more than in the previous year. They had put up 850 cooking-stoves; making the total number in use 2650. The past twelve months had seen an increase of 600 in the number of consumers, of whom they now had 3700 on the books. The business of the Company had grown to the extent of 150 per cent. since 1893, when their first Act of Parliament was granted. Last session they obtained another, which gave them power to create £60,000 of new capital; their only opponents being the Board of Trade, who wanted to alter their sliding-scale. But as they introduced a scale which no one could understand, the Bill passed through practically intact. The report was adopted, and dividends were declared of 4½ per cent. on the preference shares, 10 per cent. on the original stock, and 5 per cent. on the ordinary stock. The Directors' fees were increased from £200 to £300 per annum; and the Engineer and Secretary (Mr. J. J. Jervis) was granted £50 for extra services rendered during the year. A resolution was passed empowering the Directors to raise £10,000 of new capital, with a corresponding amount on loan; the Chairman explaining that it would be necessary to increase the gasholder capacity next year. At present they had not sufficient storage for one day's consumption during their busy time in the winter.

Water Company.

At the recent half-yearly meeting of the Sevenoaks Water Company, the Directors reported that in the six months ending June 30 there had been an increase in the revenue from the supply of water, while the expenditure had been less, as compared with the corresponding period of last year. The balance at the credit of the profit and loss account was £1677, out of which the Directors recommended a dividend at the rate of 9 per cent. per annum on the consolidated stock and £6 6s. per cent. per annum on the share capital, free of income-tax. This would absorb £1293, and leave a balance of £384 to be carried forward. The Chairman (Mr. S. Thompson), in moving the adoption of the report, said the shareholders had no doubt heard that the Urban District Council had approached the Company in reference to the sale of their undertaking; and the Directors had replied that they had no objection to a sale at a fair value. No figure had yet been named; but the Directors were making inquiries as to the terms of sale of similar undertakings to local authorities before fixing any amount which they would be prepared to recommend to the shareholders for acceptance. The report was adopted.

THE STRIKE AT THE CORK GAS-WORKS.

At the Meeting of the Cork Gas Consumers' Company on the 30th ult., at which the report and accounts referred to in last week's "JOURNAL" (p. 578) were adopted, the principal matter under discussion was the strike which recently took place at the works.

The Chairman (Mr. George Lynch), in the course of his address, said he regretted that he was unable to congratulate the shareholders on the results of the past half-year's working; the high price of coal and the extra expense attendant on the strike having largely reduced the profits. He had said at a former meeting that he saw no prospect of the dividend falling below 8 per cent.; for he could not foresee that a body of men who had been so long in the Company's employ, and who had (as they themselves acknowledged) always been treated fairly and liberally, would behave as they had done—turning their backs on their work without notice, totally regardless of the loss and inconvenience they caused the Company and their fellow-citizens, as well as the numerous workers employed in various establishments that were depending on gas-engines for power to work their machinery. He did not think there was ever a strike more entirely unprovoked or more completely destitute of any reasonable cause or excuse. The pamphlet which the proprietors had received (*ante*, p. 350) had put them in possession of all the facts. The Directors were doing all they could to keep up the supply and quality of the gas, and to lessen, as far as possible, the inconvenience that was inseparable from the circumstances; and they had to thank the consumers for the kind forbearance they had shown. The Board were pleased to know that they had the cordial support and approval of the shareholders during the time of anxiety through which they were passing.

In the course of the discussion which subsequently took place, the Rev. Father O'Donovan asked if there was any prospect of a settlement of the strike. The Chairman replied that the Company had made considerable advances to get it settled. The men had walked out of the works on their own account, without giving the Directors any notice; but the Board had repeatedly expressed their inclination to take back the larger number of them if they would come. They, however, would not do so; and they were now in the position of men standing out from their work who would not come back. They offered some few weeks ago to take back 20 men in the morning and 20 more in a week's time. They would take back 25 or 30 of them on Monday morning, if they would come; but they reserved to themselves the right of taking back only the men who were suitable and acceptable to the Manager. He believed the fact of the matter was that the vast majority of the men would be glad to come back, and would not have gone out at all, perhaps, were it not for some of the men who, before the strike began, showed a disposition to be troublesome and discontented. The men, too, had been very exacting in their conditions; putting forward conditions that the Board, as honourable men, could not accept. First of all, they wanted them to discharge the men who came to them in time of need. This was a condition which they, of course, would not accept. When they gave those men employment, they told them that as long as they did their work satisfactorily, and wished to stay, they would give them work. This condition alone would prevent the Directors from closing with the men; and if they preferred to stand out, it was their own fault. There were other conditions also that they considered they could not, as in duty bound to the shareholders, accept. They were still willing to take back any suitable men; and he took the opportunity of saying that Mr. Magrath, as a man and as a manager, was second to none in Cork in his character, respectability, and fairness, and in the reasonable treatment he gave the men. Any statements made against him were totally groundless; and he possessed the full and entire confidence of the Directors. Father O'Donovan said that, as an honourable way out of the difficulty, he would suggest that they should appoint a Committee of six shareholders, who would hear both sides of the question, and come to a decision as to the best course to be pursued. If the Directors were right, no man would uphold them more than he would. Mr. J. C. Rowe regretted that any shareholder should have seen fit to impugn the conduct of the Directors. He thought they had done all they reasonably and honourably could do to meet the men. He believed the general opinion was that their Manager (Mr. Magrath) was a very fair man. It was impossible to understand how anyone could read the pamphlet issued, and not consider that the Directors had actually gone out of their way to meet the men fairly. He thought the Directors deserved the most cordial approval of the shareholders. The Chairman remarked that the Board would be quite agreeable to the appointment of such a Committee as was suggested by Father O'Donovan; but as only one other shareholder favoured the proposal, nothing was done in the matter.

EXTENSIONS AT THE HECKMONDWIKE GAS-WORKS.

In order to enable the Heckmondwike Gas Company to cope with the increasing demand for gas, considerable extensions are being carried out at their works; and at the same time the carbonizing plant is being brought into line with modern practice. Last winter it was found necessary that alterations to the retort-house should be made for the winter of 1901-2; but, owing to the Heckmondwike and Liversedge District Councils desiring to purchase the works, and their promotion of a Bill to effect this object, the settling of new contracts was considerably delayed. After inquiry and visiting many works, the Directors eventually decided to adopt inclined retorts in conjunction with labour-saving appliances, including hot coke conveyors. A tender was obtained from Messrs. R. Dempster and Sons, Limited, of Elland, for a new retort-house and a complete installation of inclined retorts on Chester's system. It was to consist of six arches, each to contain eight retorts 20 feet long, with new chimney, coal breaker and elevator, and conveyors for both coal and coke. The Directors placed the contract with this firm on the 12th of March. Considering that the new retort-house had to occupy the same site as the existing one, which contained 72 retorts on the direct-fired system, all of which had practically been at work during the previous winter, it will be realized that the Contractors had an exceedingly difficult task before them to have the installation ready for work for the next winter. They, however, guaranteed that they would build the new house and have one setting ready for slow firing, preparatory to being put to work, by the 1st of September. The Directors and the Company's Engineer and Manager (Mr. A. F. Goodson) have naturally been very anxious that this promise should be fulfilled. The pulling down of the existing retort-bench and the retort-house commenced on the 15th of March; the foundation stone of the new building was laid on the 13th of April; and the erection of the roof was commenced on the 15th of June. The building of the gas-producing portion itself was commenced on the 21st of June; and the first setting was finished and fired up on the 31st of August. Fine weather no doubt favoured the Contractors. But they were hampered owing to the busy state of the building trade, and the difficulty experienced in obtaining sectional iron at short notice; and they could not have completed this record feat had they not employed modern steam-cranes, put up an electric light plant, and, as soon as the roof was finished, worked on the furnaces night and day. The whole of the work, including the building of the stone chimney, the coal breakers, elevators, brickwork, &c., throughout, has been carried out by Messrs. Dempster without sub-contracting of any description, with the exception of the roof slating. The new retort-house is 81 ft. 6 in. long, 60 feet wide, and 50 feet high from the ground-line to the eaves. The chimney at the gable end is

80 feet high. Both the furnaces and the hot coke conveyor are constructed on Dempster's patents. The installation when complete will, for its size, be one of the most modern and completely equipped of its kind. It only remains to say that the whole of the work has been carried out under Mr. Goodson's supervision.

MANCHESTER CORPORATION ELECTRICITY SUPPLY.

Advance in the Price of Current.

At the Monthly Meeting of the Manchester City Council, held on Wednesday last, the Electricity Committee submitted a proposal to increase the price of electric current by ½d. per unit to all consumers.

Dr. BISHOP, the Chairman, explained that the Committee felt very deeply the responsibility they were under in asking the Council to raise the price of current; but they considered that this step was quite justifiable, in view of the financial position and outlook of the department. The fact of the matter was that the price of current in Manchester had been reduced during the past few years far more rapidly than it ought to have been. They estimated a loss for the current twelve months of over £5000. If it would stop at that, it would not be so much; but with the enormous expenditure they were engaged in—much of which would have to be undertaken before they got any money at all in return—they would during the twelve months following March, 1902, have to provide no less a sum than £20,000 more for interest and sinking fund than in the current year. The £5000 would have to come out of the reserve fund, which would then be reduced to £8000; and if they had to face a further sum of £20,000 over and above what they had at present to find for interest and sinking fund, without a corresponding increase of income, their estimated loss for the following twelve months would be very considerable. They calculated that if this slightly advanced charge was put on, the result up to March 31 would be an increase of £11,000, which, added to the £8000 left in the reserve on the basis of a £5000 loss, meant that they would have £19,000 in hand on March 31 next. With this and the increased price going on for another twelve months, they would not only be able to meet obligations, but have a little to spare for contingencies; and in two or three years, with the plant running at both Bloom Street and Stuart Street, they hoped to find themselves in the position of being able to reduce the charge. The price in Manchester had so far been one of the lowest in the country. If they had had a bigger reserve fund—if they had not been so rash in giving sums to the city rates and reducing the price of current at the same time—they would not have been in the serious position they occupied to-day. Being in that position, however, they had to meet the difficulty; and to this end, he proposed that the price of energy be advanced ½d. per unit.

Mr. PHYTHIAN seconded the motion.

Mr. WILSON thought the Committee were very unwise in having taken such a proposal into consideration at all. The price of current in Manchester might be lower than in any other town—though he questioned it very much—and the department might, in the past, have declared profits they ought never to have declared, but they had to consider the fact that many people had put down machinery and motors in anticipation of a cheap supply of electricity. He could assure the Chairman that if they increased the price they would lose many good customers for motive power. He could not understand why the Committee wanted to put on an advance, especially for motive power. They might have left that alone, even if they had raised the price for lighting. The charge for lighting, however, was already too high; and they ought to be able to produce the current so as to sell it to citizens at 4d. per unit for lighting purposes.

Mr. ROYLE regretted that the Committee found themselves in such a serious position, but could not approve of the method they suggested for securing relief. It was strange that they should propose an advance which meant 30 per cent. on motive power, but only 10 per cent. on current for lighting purposes. The proposed increase seemed to be very unjust, particularly as many people had been induced, at very considerable cost, to remove gas-engines, steam-engines, &c., on the strength of the Corporation providing them with motive power of another class. The advance would tell very heavily on many small manufacturers who used the current for motive power; and it should, at any rate, be made more in accordance, in point of percentage, with the advance for lighting requirements.

Mr. GRIMSHAW said he understood that the power supply charge had hitherto been too low; and that was the branch of the electrical undertaking which was not paying as it ought to do. He saw no way out of the difficulty other than that proposed by the Committee.

Mr. HARROP said he had been assured by several manufacturers that, when they were induced to substitute electric motors for gas-engines, they had not the slightest idea that the expenses of electricity would be two-thirds greater than the cost of driving by gas; and if the proposed advance was made, these men would be put to serious disadvantage. He hoped the Chairman would make an exception in the case of such users for motive power.

Mr. BROCKLEHURST supported the Committee's recommendation. They had to meet the increased capital charges; and this would have to be done either out of the rates or out of the electricity users. He did not think it right to use public money in order to specially benefit a small class of the citizens; and in his view they would be acting in that manner if they did not increase the price of the commodity with the rise in the cost of production.

Dr. BISHOP, in replying on the discussion, said that in the past they had been supplying current for motors at a price at which they were not able to produce it; and consequently they thought that during this period of temporary depression users for motive power could reasonably be called upon to pay a little extra in proportion, as compared with consumers for lighting. It had been a sore point with him for some time past that electricity was supplied to a particular class at a price out of all reason, considering the cost of production.

On being put to the vote, the recommendation of the Committee was adopted by a considerable majority.

ELECTRIC LIGHTING NOTES.

The electric light was recently installed at St. Mary's, Bathwick, one of Bath's most fashionable churches. On Sunday evening, the 25th ult., just as the offertory hymn was started, the supply failed, and the church was put into total darkness. The choir struggled on with the hymn. One chorister boldly struck a match, and lit a disused gas-standard near him. People in every part of the church did the same; there being quite a fusilade of matches. The collection was taken, and the service concluded in the ordinary manner.

New electricity works, erected and installed by the Farnworth District Council at a cost of £24,000, were formally opened last Wednesday by Mr. Richardson, Chairman of the Electricity Committee, in the presence of a large assemblage. The laying of tiles, track, and equipments is being carried out under a Special Act authorizing a capital outlay of £102,000. It was stated, in the course of the proceedings, that, as far as was known, this was the first electrical station which, with few exceptions, had been equipped with plant made entirely in this country.

The total income from public and private electric lighting in Chester in the past financial year is £2200 in excess of the previous year, and the balance on the revenue account is £5814. From this sum must be deducted the interest on money borrowed and the sinking fund charges—viz., £4005—leaving a net balance of £1809, which amount the Committee propose to allocate as follows: Special discount to consumers of over 5000 units, £348; addition to reserve fund, £1400; and balance to be carried to next account as provision for bad debts, £61. The reserve fund now stands at £2496 (of which £2465 is invested in Consols); and the addition of the £1400 will bring it up to £3896.

After much obstruction of the streets, to the general inconvenience of the public, the electric light was last week installed at Sleaford. The darkness which has lately prevailed will henceforth, therefore, be banished. Whether the new light will give the same satisfaction as the incandescent gas system it has displaced may be doubted. The writer of the opening "Parochial Note" in the current number of the St. Deny's Parish Magazine, referring to this matter, says: "Our opinion is that up to this present summer there was no better lighted town in the county, or in the kingdom, than our own; and the effect of the electric lamps must be brilliant indeed if it so far outstrips that of the incandescent ones as to make the vast expense incurred by this latest fad in any way excusable."

A curious example of the manner in which local government areas tend to overlap each other was afforded by an inquiry held at Devonport last week. The application was by the Devonport Corporation for power to borrow £4809 for electric lighting in the urban district of East Stonehouse, the connecting-link between Plymouth and Devonport. It has its own District Council and sanitary organization, but it is supplied with water by the Plymouth Corporation and with gas by the Plymouth and Stonehouse Gas Company. Now it is to take its electrical supply from the works of the Devonport Corporation, which are, as a matter of fact, situated in East Stonehouse and not in Devonport. Though it is much smaller than its neighbours, which hedge it round on every side, East Stonehouse is emulative. It is going to adopt electric lighting, though the example of Plymouth in this respect can scarcely be regarded as encouraging.

Considerable discussion has taken place with respect to the charges for electricity at West Bromwich; and the Committee of the Town Council have resolved—"That the price per unit be 4½d. for one hour's use per day throughout the quarter; for two hours' use, 3d. per unit; for three hours' use, 2½d. per unit; for four hours' use, 2¼d. per unit; for five hours' use, 2d. per unit." This is exactly equivalent to 4½d. for the first 91 hours of the quarter, and 1½d. per unit for all above; and it works out at the same cost to the consumer as so much per unit per hour. The Committee have made known their recommendation that intending consumers might make arrangements for fitting up their shops, houses, and premises for the coming winter. They formerly charged 3d. per unit for the first hour for power purposes, and 1d. per unit for all above. They now recommend that the 3d. rate be abolished, and only a uniform rate of 1d. per unit be charged in future for power purposes.

At the last meeting of the Electric Lighting Committee of the Sunderland Corporation, it was decided to ask the Council to instruct the Finance Committee to apply to the Local Government Board for leave to borrow £30,000, partly for the new station in Hylton Road, and partly for the existing station in Dunning Street. The scheme includes £7673 for the extension of mains, and upwards of £12,000 for extensions. The question of a reserve fund was considered; and it was found that there ought to be a reserve of £5000, whereas the Committee had only set aside, up to now, £1257, which, with an estimated credit balance on the current half year of £1034, made a total of £2291. In face of these facts, the Committee resolved that it was undesirable to apply any of the profit in the reduction of the ensuing rate. In the first two years of the undertaking, the Committee had to draw £1849 from the rates; yet, as a business concern, they have paid in rates £1631, and set aside as a sinking fund £8870.

Some feeling has not unnaturally been excited at Barnstaple by the unexpected ruling of the Mayor that shareholders in the Gas Company cannot take part in the discussion of the electric lighting scheme, the effect of which was to debar Mr. Chanter from moving the resolution, of which he had given notice, in opposition to the scheme. The subject was referred to at a meeting of the Council recently held, when Mr. S. N. Petter asked if gas shareholders were to be debarred from voting on any matter relating to the lighting of the town. No direct answer was given to the question. Mr. F. W. Petter said that eighteen months ago the Town Clerk told him that being a shareholder in the Gas Company did not debar him from voting. The Town Clerk replied that Mr. Petter was mistaken. His recollection was quite to the contrary. The subject then dropped, though it cannot be said that the members were entirely satisfied; and the question is likely to be again raised on a motion to relieve the members owning gas shares from attendance on the Lighting Committee.

Several thousand visitors at St. Anne's-on-the-Sea met with a great disappointment on Saturday, the 31st ult. During the day a regatta

and gala had taken place, and the Promenade Band announced a vocal and instrumental concert for the benefit of their funds. The evening was very fine, and at 7.30 nearly all the chairs were occupied at 6d. each, and the promenading enclosure was packed with people. The orchestra took their places, but the electric arc lamps refused to be switched on. There was no supply of current, and for an hour the people sat in darkness, waiting for a light, which never appeared. The Conductor announced that the Secretary and Chairman of the Urban District Council had communicated with the Electrical Engineer, and an electrician would be down shortly, when the concert would proceed. An hour passed, and the crowd became impatient. No electrician arrived, and the further announcement was at length made that the concert would be postponed till the following Monday evening, when the same tickets would be available. The audience met the situation good humouredly, and retired to their apartments with an evening's enjoyment spoiled, and commenting strongly on the town's Electric Light Department.

In spite of some doubts as to the ultimate effect of their action, the Penzance Corporation seem likely to be definitely committed to an electric lighting scheme. Last Wednesday week, the Town Council adopted a recommendation of the Electric Lighting Committee, to the effect that Mr. W. H. Trentham should be invited to report upon the best means of carrying out the Electric Lighting Order. An inquiry had, it appeared, been made on behalf of an electricity supply company in London as to whether the Corporation intended to move in the matter, and the reply had been made that the Corporation would take steps to fulfil their obligations under the Order. Alderman Bazeley said that the Committee did not come before the Council with any definite recommendation, because they felt that they ought to have more information. The deputation which made inquiries at Plymouth and Torquay found that in much larger areas than Penzance electricity was introduced at a cost far below that estimated for that town. It was a big undertaking, but other towns found that, however big the scale on which they began, the demand for electric light almost invariably overtook the supply. They would probably gain by delay, and, at all events, they would run less risk than if they proceeded without adequate information.

It appears from an article in the "Ayrshire Post" dealing with the annual balance-sheet of the town, that the financial condition of the borough is not so satisfactory as could be desired. With regard to electric lighting, the position in which the account stands is characterized by the writer as "serious." He justifies this expression by the following remarks: "When it is mentioned that the account closes with a deficiency of £1127 2s. 6d., and when it is borne in mind that this sum would have been increased by not less than £100 had the accounts closed at the 31st instead of the 15th of May, it will be seen that the position is not in the least overstated. The deficiency is equal to 2d. per pound on the rates. There is surely something here calling for the closest investigation by the Town Council, as to how it comes that the deficiency for the past year should be upwards of £500 more than the previous year. It is now six complete years since the works were in full going order, and surely, with careful management, the balance should have been on the right side by this time. If the latest undertaking of the Council is to prove anything like so expensive a luxury, then better far to lease the tramways at once. Because to really see what the electric light is costing the rates, a comparison has to be made with what it cost to light the town before the installation, and what it costs now. For the year ending May 31, 1895, the total cost for lighting the streets by gas, including wages and upkeep, was £1499 7s. 3d.; last year it was £3193 16s. 9d.—an increase of about £1694. Of this large sum, £2065 was for electric light, the balance for gas, including lamplighters' wages, £1128 16s. 9d. One way and another, the light is costing the rates not less than from 3d. to 4d. per pound, and this, it must be admitted, is far too much, even although the streets are better lighted with it than gas. As has already been pointed out, the position of this department is such that it is the duty of the Town Council to leave no stone unturned to have it put on a satisfactory footing. Since the works were in full going order, the deficiency has been as follows: Year to May 31, 1896, £252 7s. 10d.; to May 31, 1897, £1327 1s.; to May 31, 1898, £1155 6s. 11d.; to May 31, 1899, £747 2s. 4d.; to May 31, 1900, £695 16s. 8d.; to May 15, 1901, £1127 2s. 6d.—total deficiency, £5304 17s. 4d. The average for the six years is £884 2s. 10d. per annum, or an average of fully 1¼d. per pound on the rates."

LIVERPOOL CORPORATION WATER SUPPLY.

Water Engineer's Annual Report.

The Water Engineer of Liverpool (Mr. Joseph Parry, M.Inst.C.E.) has just issued his annual report, which, as usual, furnishes some interesting information as to all the water sources available for the city. The total quantity of water delivered from the works of the Corporation during the year 1900, including compensation water to rivers in Lancashire and Montgomeryshire, was 16,312,075,000 gallons. The quantity supplied for domestic, trade, and public purposes within the compulsory area in and around the city last year was 9,314,375,000 gallons; in the town of Chorley, 170,022,000 gallons; in towns and districts outside the compulsory limits, 484,755,000 gallons—making a total of 9,969,952,000 gallons, or an average of 27,390,000 gallons per day. The quantity of water supplied for domestic purposes (this term comprising hotels, public-houses, warehouses, offices, shops, and waste and leakage from public and private pipes and fittings) within and around the city was 5,466,490,000 gallons—being an average of 15,018,000 gallons per day, and 18·106 gallons per head per day—against 5,255,453,000 gallons in the preceding year. There was an increase of 36,144,000 gallons in the quantity of water supplied by meter, notwithstanding the fact that two firms consumed 51,449,000 gallons less than in 1899. Had it not been for this, the meter supplies would have been 87,593,000 gallons. The total quantity of water distributed during the past year was 261,900,000 gallons in excess of that of 1899; being an average increase of 719,000 gallons per day. The highest winter consumption was during the week ending the 17th of February, and amounted to 221,647,000 gallons; being equal to an average of 31,663,856 gallons per day. The highest summer consumption occurred during the week ending the 28th of July, and amounted to 204,528,000 gallons, or an average of 29,218,286 gallons per day. The highest winter consumption in any one day took place on the 16th of February, when the quantity distributed was 36,704,000 gallons; and the highest summer day consumption was on the 20th of July, when it was 31,895,000 gallons. The water was derived from the several sources in the following proportions: From Vyrnwy, 46·25 per cent.; from Rivington, 40·52 per cent.; and from wells, 13·23 per cent. The total length of new distributing and fire mains laid during last year was 10 miles 767 yards. The number of new fire hydrants fixed was 141; and 210 were substituted for plugs—making the total number of hydrants fixed during the year 351. For the prevention of waste, 198,842 inspections were made and 41,828 defects discovered, of which 16,878 were repaired by the inspectors at the time of their visit. There were 68,799 fittings of various kinds tested; the fees charged amounting to £769. The total capital expenditure on the works to Dec. 31 last was £5,017,470, of which £2,216,662 was for the Vyrnwy section. The ordinary revenue last year, including Chorley, was £289,404. Following Mr. Parry's report is that of Professor Boyce, on his bacteriological analyses of the water, which show it to be very satisfactory.

ADDITIONAL WATER STORAGE IN THE TEES VALLEY.

Last Tuesday, a formal commencement was made with the two new service reservoirs which are to be constructed for the Tees Valley Water Board at Long Newton, ten miles from Middlesbrough, by the cutting of the first sods by Alderman R. Hind (Mayor of Stockton) and Alderman W. Anderson, of Thornaby, respectively. The reservoirs are to be 1400 feet in length, 560 feet wide, and 18 feet deep, and to be equal to holding 200 million gallons of water. Alderman Hugh Bell, Chairman of the Water Board, presiding at the luncheon after the ceremony, said the new reservoirs would hold a quantity of water very much in excess of any immediate requirements. The present consumption in the district was something over 80 million gallons per week, and the reservoirs would hold two or three weeks' supply. This was more than was absolutely necessary; but he was glad to believe that it would not be so long. The growth of the demand in the district was such as to make it very essential for the Board to look well ahead. The Mayor of Stockton reviewed the history of the undertaking since the Water Company obtained their Act fifty years ago, and commenced to supply the district with water. The Corporations of Stockton and Middlesbrough took action to compel the Company to sell their undertaking; and in 1876 they entered into possession of the works. In 1852, the population supplied with water was 8000; in 1876 it was 120,000; and to-day the Board supplied 230,000. The quantity of water furnished in 1863 was 10 million gallons per week. In 1900 they supplied 64 million gallons per week for trade, and 21 millions for domestic purposes. In 1852 the Company took £110 for supplying water; in 1876 the takings had risen to £40,000; and in 1900 they were £94,000. Alderman Anderson stated that the new reservoirs were 160 feet above the level of Middlesbrough. The total cost of the undertaking would be about £180,000; but the estimate might be exceeded. Whatever the Water Board undertook, however, was in the interest of the whole district. The proceedings then closed.

NOTES FROM SCOTLAND.

From Our Own Correspondent.

Saturday.

The Great International Engineering Congress was held in Glasgow this week. On such a subject, it is difficult to give an opinion, because it was too vast for comprehension, and to treat it in detail would be a monotony. In a general way, satisfaction must be expressed at the quality of the papers. It may be that this was determined, or governed, by the fact that the authors were, for the most part, men engaged in engineering pursuits; but, whatever the reason was, there was very much of practicability, and very little of the abstractly theoretical, in nearly all that was written. The congress was an assemblage of engineers in actual service, who gave freely out of their stores of attained knowledge, and not of students who were striving to acquire the learning which would fit them for service. A glance down the list of subjects discussed, reveals this. The number of men of mark who contributed papers is a very large proportion of the whole; and of the subjects discussed, it is impossible not to be impressed with the feeling that engineering more than management—construction more than working—was the spirit in which they were framed. In the Gas Section, that was so in all but one of the contributions; and that one, strangely, was a highly important and most valuable address by Professor Lewes, who dealt with the process of working, not with provision for it. The attendance of the gentlemen from abroad was welcome. There is no process for the widening of the thoughts of men equal to that of interchange of ideas. That was enjoyed to the full in the congress, which may well and fitly be described as a great intellectual feast.

In connection with the Congress, and forming part of the work arranged for, was the visit which was paid to the Dawsholm Gas-Works, and to the new gas-works which are being erected at Provan by the Corporation of Glasgow. The Engineer (Mr. W. Foulis) accompanied the visitors, and pointed out the outstanding features of the works. I suppose that what impressed the strangers most, after the immensity of the places, was the working of the outside producers at Dawsholm. This method of firing retorts is so uncommon, that very few who were present had ever seen it before. There are four producers, square in form, placed close together alongside, but not quite against, the outside wall of the retort-house. One man attends to the plant; and his labours do not seem to be very hard, as during the whole time of the visit he did nothing but contemplate the crowd. All the same, the process must require great attention in the working; for the gas is consumed as produced, and any inattention at the producers would at

once affect the heating of the retort-bench. The absence of producers in the retort-house has the effect of quite appreciably reducing the temperature, thereby making the place much more comfortable to work in. The Provan works are in an interesting stage. The retort-house and coal-store of the first section is about ready for the roof; and the chimneys are erected. Alongside the ground is being levelled for the purifier-house. The scheme of the works is that coal and lime will be brought in at the high level; and in working every movement of material will be in a downward direction, advantage being taken of the law of gravitation to assist the work. Then the first section of the works is the retort-house and purifier-house alongside each other. The next section will have these houses, the retort-house to the north of the present one and the purifier-house to the south of the one which is about to be erected. That is, the construction of the works has been begun in the centre line of the field; and they will, as more are required, spread outwards in both directions. The tank for the new gas-holder of 8½ million cubic feet capacity, is nearly half built. It formed a vast object-lesson, more profitable to many than it would have been had the structure been in a more advanced stage.

Those attending the Congress who were also members of the Incorporated Institution of Gas Engineers, had the unique experience of visiting new works in course of erection on a large scale in two cities—Edinburgh and Glasgow. The visit to Edinburgh was paid on Monday. The works at Granton are more advanced than those at Provan; the retort-bench being all but completed, and the coal-handling machinery so far finished that a portion of it was seen in motion. The gasholder in which the luncheon was held was to be completed in a day or two; and the residual products works have been in operation for several months, upon materials brought by rail from the existing works in Edinburgh and Leith. Least progress has been made with the purifying plant. There is already about 10 feet of water in the tank of the gas-holder; the water being obtained from a disused quarry in the grounds. Those who saw both the Edinburgh and the Glasgow works would observe how complete are all the arrangements in both places for carrying on operations in the portions which are in hand, and for additions to them. Where they differ is in the stoking—one being by inclined retorts, and the other by machinery. After the visit to the gas-works, the Engineer (Mr. W. R. Herring) entertained the members of the Institution within the grounds of Granton House. These were looking their best in the bright afternoon; and an exceedingly pleasant garden party was held within the precincts of what is probably the most sumptuous residence of any gas engineer and manager in the world.

The contract for erecting the two large holders at the Provan Gas-Works, Glasgow, has been let to Messrs. R. Laidlaw and Son, Glasgow. There were some seven or eight firms tendering for the job, including Messrs. Hanna, Donald, and Wilson and Messrs. Clayton, Son, and Co., Limited, both of which firms have in past years done a large amount of holder work for the Gas Commissioners. The holders are to be 250 feet in diameter, each having three lifts 50 feet deep; while the capacity of each holder will be about 8½ millions. It is said that the cost of the two will amount to six figures; and in giving them both, the Commissioners were, we believe, tempted by the promise to lop off a sum of £500 from the total price. Sir William Arrol and Co. will, as on former occasions, be associated with Messrs. Laidlaw and Son in the construction of the holders, which will be among the biggest yet erected.

Amid the many gatherings which took place in Glasgow in connection with the Congress, there was one—the formal opening of the James Watt Engineering Laboratory in Glasgow University—which is of interest to gas managers in more respects than one. The laboratory has been erected, and is being equipped, at a cost of over £25,000. It is one of the most complete institutions of its kind, and will be of great service in the technical training of all workers in minerals, including gas engineers. But there is another and very potent reason why gas managers have an interest in the laboratory, which is found in the fact that within it is located the Murdoch Memorial Gas-Engine, the gift to the University of the North British Association of Gas Managers. In November, 1896, the Committee of the Association handed over the engine—a 10-horse power one by Crossley Bros.—to the late Principal Baird, of the University, for the use of the students in the engineering laboratory. The engine was placed, temporarily, in an apartment in the basement of the building. Now when the permanent building of the laboratory has been erected, the engine is being transferred to it, and will there occupy a prominent position. When the engine was originally supplied, it was of the most modern pattern. It is now a little antiquated in some parts; and in this connection it deserves to be noted that Messrs. Crossley Bros. have most handsomely taken back the old engine, and are furnishing a new one, of the same capacity and of the most modern description, free of charge. At the opening ceremony on Tuesday, there was a large attendance of engineers, presided over by Sir William Arrol. Lord Kelvin delivered the opening address. Both he and the Chairman referred in appreciative terms to its being most fitting that there should be in the laboratory a monument to the great Engineer, William Murdoch, whose name was so much associated with the discovery of coal gas for illuminating purposes. The North British Association were represented at the opening ceremony by Mr. J. M'Gilchrist, of Dumbarton, who was Convener of the Murdoch Memorial Fund Committee, and to whose untiring exertions the success of the fund may be said to be almost wholly due.

The Gas Committee of the Dundee Town Council on Wednesday discussed a question relating to the employment of tradesmen in the gas-works. Several members thought that now that the new system of working was getting into order, inquiry should be made into the organization of the works, with special reference to the large number of workmen employed, not in gas manufacture, but in the upkeep and repair of buildings and machinery. One member thought there appeared to be too many foremen about, and several were at a loss to know how they all found work. A Sub-Committee was appointed to visit the works, and, with the assistance of the Manager (Mr. W. M'Crae), find out how all the men filled in their time, and if the staff needed reduction or redistribution.

This resolution of the Committee was approved by the Council at a meeting held on Thursday. Bailie Melville spoke with satisfaction of the appointment of the Committee, and said that some of them felt it ought to have been done before. In a conversation which took place, reference was made to a proposal to retire men from service in the gas-works at 45 or 50 years of age; but any such question will fall to be dealt with by the Sub-Committee. The Convener corrected an erroneous impression to the effect that when twenty-four of the workmen were dismissed, six new men were taken on. Only one man had been taken on, as a night-fitter. A councillor drew attention to the emission of gas and smoke from the new works, and complained that if there were no improvement the district would be depopulated. It was explained that they were using North of England coal in the works; but that after the 500 tons on hand were exhausted, no more would be taken. Probably, the nuisance would be then found to have abated.

The Corporation of Aberdeen, on Monday, considered the gas accounts for the year ending in July. Mr. Kemp, the Convener of the Gas Commissioners, in presenting the accounts, said the revenue from the sale of gas had increased during the year by £13,008, of which £3085 represented the increase in the amount received through pre-payment meters. Receipts from coke rose £2046; but from tar and liquor they decreased by £1238. From gas-stoves there was an increase of £527. On the expenditure side, coal had risen £19,525, purifying materials £496, and wages £1702. Last year, although the contracts which had been entered into would have justified an increase of 6d. in the price of gas, the Council resolved to only raise the price by 2d. per 1000 cubic feet. The intention was to absorb a free balance of about £10,000 which they had in hand. This had been all but accomplished; the balance now to be carried forward amounting only to £146. The quantity of gas manufactured was 48,537,000 cubic feet more than in the preceding year. In ordinary circumstances, this would have been a most satisfactory increasing business; but it meant in their case a most unsatisfactory increasing loss. The average price of coal last year was 21s. 9¾d. per ton, as compared with 16s. 8½d. in the preceding year. The make of gas was 12½ million cubic feet beyond the estimate. They congratulated themselves on having come through the year so well as they had done. For this year, they estimated an output of 600 million cubic feet of gas, which was 27½ million cubic feet over the output of last year. To make the increased output, they calculated that they would pay £4055 for coal. The total revenue was estimated at £114,000, and the expenditure at £115,834. After wiping out the £146 carried forward, the estimates provided for a deficit on the working for the current year of £1688. They believed that the experience of the past year amply justified the wisdom of their decision not to put a substantial increase on the price of gas merely for the pleasure of announcing a handsome balance at the end. The approval of the accounts was seconded by Lord Provost Fleming, and was unanimously agreed to.

The Council also had before them the recommendation of the Gas Committee not to entertain the application by the gas workers for an increase of wages. Upon this subject there was a discussion of the usual type, which ended, however, in the Committee's report being adopted by 16 votes to 13. A meeting of the Aberdeen Trades Council was held on Wednesday night, at which a gas worker said he denied the statement of the Convener regarding Sunday labour in the gas-works, which had existed ever since the works were established. The gas workers had not decided what they were going to do. A meeting of them had been held that night; but on account of the men working in shifts, the attendance was not so large as had been desired. They expected soon to receive from the executive of their Union some indication as to the steps they ought to take in this matter. Regarding this, two remarks are permissible—first, that it is the Union who work the movement, and not the men themselves; and, second, that it would seem as if the decision of the Town Council would be acquiesced in without cavil.

The proceedings at the annual meeting of the Carnoustie Gas Company last Wednesday were of unusual length; the report of them occupying nearly a column-and-a-half of a newspaper. This was owing to the calling in question of the doings of the Directors by Mr. J. Hunter, jun., a solicitor, of Dundee. The Directors reported an income of £3603, of which £3153 was derived from the sale of gas; and an expenditure of £2968, of which £1787 was for coal. The balance of profit was £635. Out of this, £180 was set apart for depreciation; a dividend at the rate of 7½ per cent. was paid, absorbing £450; and after allowing for bad debts to the amount of 35s., a balance of about £3 was added to the reserve fund, which now stands at £2592. The quantity of gas sold was 13,760,500 cubic feet—an increase of over 300,000 cubic feet—and the price charged was 4s. 7d. per 1000 cubic feet. It appears that since Mr. J. W. Napier was appointed Manager, the business has greatly increased; and the Directors during the past year were under the necessity of erecting a new gasholder. To enable this to be done, they purchased land adjoining the works, at the price of £1000; and they are expending about £4000 upon the holder. Mr. Hunter put a series of questions, in the replies to which he elicited the information that the Directors did not consult the shareholders before proceeding with the construction of the new holder; that part of an overdraft of £313 had been required to pay the dividend, regarding which it was explained that this was quite a common practice, and that the money had been actually earned; that the reserve fund was invested in the works; and that the land for the site of the new holder had been purchased from one of the shareholders. Mr. Hunter moved an amendment to the motion of the Chairman, to the effect that the report of the Directors be not adopted, on account of its being too vague and indefinite; but that they be instructed to remodel the report and balance-sheet and submit them to another meeting of the Company. The amendment was not seconded, and the report was thus adopted. Thereafter notice was given by the Board of their intention to borrow £6000 to pay for the extensions to the works. Mr. Hunter thought that £3000 would be sufficient to borrow; but he again received no support. There is nothing to suggest that the Company is otherwise than handsomely managed.

The Directors of the British Gaslight Company, Limited, recommend a dividend at the rate of 10 per cent. per annum for the half year ending the 30th of June.

CURRENT SALES OF GAS PRODUCTS.

LIVERPOOL, *Sept.* 7.

Sulphate of Ammonia.—There has been a steady demand, with a hardening tendency in prices; and the closing quotations are £10 10s. to £10 12s. 6d. per ton f.o.b. Hull and Leith, and £10 15s. f.o.b. Liverpool. For delivery up to the end of the year, £10 17s. 6d. per ton, ordinary terms, f.o.b. Leith, is still quoted; and £10 15s. per ton, Beckton terms, London. But although there is good inquiry in this position, buyers have not made up their minds to pay the premium required on spot prices.

Nitrate of Soda has been advanced to 9s. 1½d. and 9s. 3d. per cwt. for ordinary and refined qualities respectively, on spot. There is also large inquiry for autumn cargoes; and an advance on recent currencies would now have to be paid.

LONDON, *Sept.* 7.

Tar Products.—The markets are generally quiet; and there does not seem to be much life in tar products at present. Pitch remains very steady; and the demand for South Wales continues, although consumers do not care to purchase for 1902. As regards the London market, the demand is scarcely so good; and there is rather more offering by dealers. In benzol, some 90 per cent. has been sold at 9½d. f.o.b. London, prompt shipment; but a sale is reported at 9d. at an outport. In 50-90 per cent. there is nothing fresh to report; there being an absence of business in the article. Anthracene remains in precisely the same position. At the present price it cannot pay to extract this article. Carbolic acid is still very dull, and consumers will not pay over 1s. 10d. for October-December; while as regards next year, they are inclined to wait before contracting. Crystals are quiet. A small sale of 34-35's is reported at 7⅞d. prompt; but this is rather over the actual market value. Creosote is also very dull, and there is no demand, especially in the North, where makers are anxious to reduce their stocks. In solvent, some small transactions are still taking place; but the price shows no signs of improvement. Respecting tar, there is nothing of importance to report; no large contracts being at present in the market.

The average values obtaining during the week are: Tar, 14s. 6d. to 18s. Pitch, east coast, 30s. 6d. to 31s.; west coast, 28s. to 28s. 6d. Benzol, 90's, 9d. to 9½d.; 50's, 9d. to 9¼d. Toluol, 10d. Crude naphtha, 4¼d. Solvent naphtha, 11d. to 1s. Heavy naphtha, 10d. to 11d. Creosote, 1d. to 1⅛d. Heavy oils, 2d. Carbolic acid, 60's, 1s. 10d. Naphthalene, 60s. to 70s.; salts, 30s. to 35s. Anthracene, "A," 2¼d. to 2⅝d.; "B," unsaleable.

Sulphate of Ammonia.—The market remains quiet, and there is not much business doing. Beckton still quotes £10 15s.; but as another London Gas Company accepted £10 10s., it is impossible for them to realize the price they ask. In Hull, business is reported at £10 8s. 9d.; while £10 10s. was refused for one of the best makes, October shipment. Further business is reported in Leith at £10 8s. 9d. and £10 10s.; 100 tons having recently been sold at the latter price. The demand for Liverpool has improved, and business has been done at £10 12s. 6d.

COAL TRADE REPORTS.

Lancashire Coal Trade.—Business is briskening up, so far as the demand for house-fire qualities is concerned; but with regard to other descriptions of fuel, no really material change can be noticed in the position generally. Pits here and there are working fuller time; and there is very little stock now going down in the better qualities of round coal. Prices are firm at the full list basis rates ruling last month—averaging 15s. per ton at the pit for best Wigan Arley, 13s. to 13s. 6d. for Pemberton four-feet and seconds Arley, and 11s. to 11s. 6d. for common house coal. Common round coals still move off but moderately, for iron-making, steam, and general manufacturing purposes, with 8s. 6d. to 9s. per ton at the pit representing very general figures for ordinary descriptions; while for shipment low prices are still taken—ranging from 9s. 6d. to 10s. per ton for inferior sorts, with better qualities quoted at 10s. 3d. to 10s. 6d., delivered at the Mersey ports. Slack is perhaps slightly more plentiful; but this chiefly applies to the lower qualities, the present output of the better sorts still moving away readily, with prices firm on the basis of about 8s. per ton at the pit. Common sorts of Lancashire slack can be bought at from 5s. 6d. and 6s. per ton upwards, with the lower qualities of slack offering from other districts at from 2s. 6d. and 3s. upwards. For coke there is a good inquiry, with a continued gradual hardening in local makes suitable for furnace purposes, which are now quoted from 14s. to 15s. per ton. Foundry cokes are firm at from 24s. to 25s. per ton at the ovens.

Northern Coal Trade.—There is a rather quieter tone in the steam coal trade, though the collieries have generally full work for a fortnight to come; but beyond this, orders are less plentiful. Best Northumbrian steam coals are from 13s. to 13s. 3d. per ton f.o.b., second-class steam coals are 12s. 6d. to 12s. 9d., and steam smalls are from 5s. 3d. to 5s. 9d. In the gas coal trade, the pressure of the demand seems the fullest; and for prompt delivery prices are very firm. Even at high prices, the best Durham gas coals are not very easy to obtain. As much as 12s. per ton f.o.b. has been paid for occasional cargoes; while 9s. to 9s. 6d. is the quotation for delivery over next year. Quantities sent to the South are now steadily increasing; and this will continue for three months. But the companies seem to be taking advantage of the period of cheap freights. In the coke trade there is more steadiness. Best Durham coke for export is now quoted at from 17s. 6d. to 18s. 6d. per ton f.o.b.; and blast-furnace coke is firmer at 16s. per ton, with a larger demand. Gas coke is generally steady; but at some of the inland towns it is possible that the price may be reduced. It is noticeable that 130 tons of gas coke were shipped a few days ago from the Tees to London.

Scotch Coal Trade.—The award of Sheriff Jameson as Arbitrator in the matter of miners' wages, was issued on Wednesday last, and is altogether in favour of the masters. The miners' wages will therefore be reduced by 12½ per cent. on the 1888 basis, equal to 6d. per day. But they have still a very good wage—6s. per day, which is 6d. above

GAS AND WATER COMPANIES' STOCK AND SHARE LIST.

Referred to on p. 650.

Issue.	Share.	When ex-Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk	Yield upon Investment.
£			p.c.	GAS COMPANIES.			£ s. d.
590,000	10	Apl. 12	10½	Alliance & Dublin 10 p.c.	18¼—19¼	..	5 7 8
100,000	10	,,	7½	Do. 7 p.c.	13—14	..	5 7 2
300,000	100	July 1	5	Australian 5 p.c. Deb. .	100—102	..	4 18 0
200,000	5	May 15	6½	Bombay, Ltd. . . .	6¼—6⅜	..	4 16 4
40,000	5	,,	6½	Do. New, £4 paid	4¼—4⅜	..	5 9 5
380,000	Stk.	Aug. 15	12	Brentford Consolidated	260—265	..	4 10 7
270,000	,,	,,	9	Do. New . . .	187—192	..	4 13 9
50,000	,,	,,	5	Do. 5 p.c. Pref. .	126—130	..	3 16 11
206,250	,,	June 14	4	Do. 4 p.c. Deb. .	111—114	..	3 10 2
220,000	Stk.	Mar. 14	10	Brighton & Hove Orig.	222—227	..	4 8 1
246,320	,,	,,	7	Do. A. Ord. Stk. .	155—160	..	4 7 6
1,047,500	Stk.	Aug. 28	5	Bristol, 5 p.c. max. .	116⅜—117⅛*	..	4 5 1
420,000	20	Mar. 28	10	British.	41½—42½	+⅛	4 14 1
50,000	10	Aug. 15	12	Bromley, Ord. 10 p.c. .	24—26	..	4 12 4
82,850	10	,,	9	Do. 7 p.c. . . .	19—21	..	4 5 8
500,000	10	May 31	6	Buenos Ayres (New) Ltd.	9—9⅛	..	6 6 4
220,000	Stk.	June 28	4	Do. 4 p.c. Deb.	94—97	..	4 2 6
150,000	20	July 17	8½	Cagliari, Ltd. . . .	22—24	..	6 17 6
100,000	10	May 31	10	Cape Town & Dis., Ltd.	15—16	..	6 5 0
50,000	50	May 2	6	Do. 6 p.c. 1st Mort.	52—54	..	5 11 1
550,000	Stk.	Apl. 12	12	Commercial Old Stock	270—280	..	4 5 9
236,425	,,	,,	9	Do. New do. .	205—210	..	4 5 9
238,237	,,	June 14	4½	Do. 4½ p.c. Deb.	130—135	+2	3 6 8
800,000	Stk.	May 31	9	Continental Union, Ltd.	158—163	..	5 10 5
200,000	,,	,,	7	Do. 7 p.c. Pref.	162—167	..	4 3 10
575,000	Stk.	Aug. 29	5	Crystal Palace Ord. 5 p.c.	120—125*	..	4 0 0
60,000	,,	,,	5	Do. 5 p.c. Pref.	123—128*	..	3 18 2
486,090	10	July 17	10½	European, Ltd. . . .	19—20	..	5 5 0
354,060	10	,,	10½	Do. £7 10s. paid	14—15	..	5 5 0
15,079,885	Stk.	Aug. 15	4 1/16	Gas-light and Coke { 4 p.c. Ord. . .	93—95	+2	4 12 6
2,600,000	,,	,,	3½	3½ p.c. max. .	88—90	..	3 17 9
3,799,735	,,	,,	4	4 p.c. Con. Pref.	111—114	+1	3 10 2
4,063,425	,,	June 14	3	3 p.c. Con. Deb.	91—93	..	3 4 6
70,000	10	May 31	8	Hongkong & China, Ltd.	13—14	..	5 14 4
3,800,000	Stk.	May 15	10	Imperial Continental .	209—212	+1	4 14 4
473,600	Stk.	Aug. 15	3½	Do. 3½ p.c. Deb. Red.	99—101	..	3 9 4
561,000	Stk.	Aug. 29	10	Liverpool United A	231—233*	..	4 5 10
718,100	,,	,,	7	Do. do. B	170—172*	..	4 1 5
306,083	,,	June 28	4	Do. do. Deb. Stk.	118—120	..	3 6 8
75,000	5	June 14	4	Malta & Medn., Ltd. .	4½—5	..	4 0 0
560,000	100	Apl. 1	5	Met. of 5 p.c. Deb.	106—109	..	4 11 9
250,000	100	,,	4½	Melbourne 4½ p.c. Deb.	103—105	..	4 5 9
541,920	20	May 31	3½	Monte Video, Ltd. . .	9—10	..	7 0 0
717,946	Stk.	Aug. 9	8½	Newc'tle & G'tesh'd Con.	224—226	−1	3 15 3
312,855	Stk.	June 28	3½	Do. 3½ p.c. Deb.	97—99	..	3 10 8
150,000	5	May 15	8	Oriental, Ltd. . . .	7⅞—8¼	..	4 17 5
135,000	5	,,	8	Do. New, £4 10s. pd.	7—7⅛	..	4 16 0
15,000	5	,,	8	Do. do. 1879, £1 pd.	1¼—1⅜	..	4 11 5
					*Ex. div.		

Issue.	Share.	When ex-Dividend.	Dividend or Dividend & Bonus.	NAME.	Closing Prices.	Rise or Fall in Wk.	Yield upon Investment.
£			p.c.	GAS COMPANIES.			£ s. d.
60,000	5	Feb. 28	7	Ottoman, Ltd. . . .	5⅝—6⅛	..	5 12 0
851,070	10	Apl. 26	7	River Plate Ord. . .	10½—11⅛	..	6 4 5
250,000	Stk.	June 28	4	Do. 4 p.c. Deb..	96—98	..	4 1 8
250,000	10	Mar. 28	8	San Paulo, Ltd.. . .	10½—11⅛	..	6 19 1
135,000	Stk.	Mar. 14	10	Sheffield A	242—247	+2	4 1 0
209,984	,,	,,	10	Do. B	242—247	+2	4 1 0
523,498	,,	,,	10	Do. C	242—247	+3½	4 1 0
5,761,885	Stk.	Aug. 15	5	South Met., 4 p.c. Ord.	125—128	+1	3 18 2
1,627,965	,,	July 17	3	Do. 3 p.c. Deb. . .	91—94	..	3 3 10
380,940	Stk.	May 15	5	Southampton Ord. . .	106—111	..	4 10 1
70,825	,,	July 17	4	Do. 4 p.c. Deb.	104—109	..	3 13 5
120,000	Stk.	Aug. 29	5½	Tottenham and Edmonton { A. 5 p.c.	113—118*	..	4 13 3
250,520	,,	,,	4	B. 3½ p.c.	82—87*	..	4 12 0
182,380	10	Jan. 16	5	Tuscan, Ltd.. . . .	8—9	..	5 11 1
149,900	10	July 1	5	Do. 5 p.c. Deb. Red.	95—100	..	5 0 0
230,000	5	Aug. 15	9	West Ham, 10 p.c. . .	9—10	..	4 10 0
172,000	10	,,	6	Do. 7 p.c. . .	11½—12½	..	4 16 0
140,900	Stk.	June 28	4	Do. 4 p.c. Deb.	103—108	..	3 14 1
				WATER COMPANIES.			
780,599	Stk.	June 28	11	Chelsea, Ord. . . .	290—295	+3	3 14 7
150,000	,,	,,	5	Do. 5 p.c. Pref. .	150—155	..	3 4 6
160,000	,,	,,	4½	Do. 4½ p.c. Pref. '75	137—140	..	3 4 4
175,785	,,	Mar. 28	4½	Do. 4½ p.c. Deb. .	140—145	..	3 2 1
1,720,560	Stk.	Apl. 12	7	East London, Ord.. .	187—192	..	3 12 11
654,740	,,	June 14	4½	Do. 4½ p.c. Deb. .	143—148	..	3 0 10
980,169	,,	,,	3	Do. 3 p.c. Deb. .	94—96	..	3 2 6
700,000	50	June 14	8	Grand Junction { 10 p.c. max..	105—108	+2	3 14 1
310,000	Stk.	Mar. 28	4	4 p.c. Deb..	123—127	..	3 3 0
708,000	Stk.	Aug. 15	14	Kent	275—285	..	4 18 3
160,000	,,	,,	7	Do. New, 7 p.c. max..	198—203	..	3 9 0
1,043,800	100	June 28	10½	Lambeth, 10 p.c. max..	270—275	+3	3 16 4
406,200	100	,,	8	Do. 7½ p.c. max..	207—212	+3	3 15 6
350,000	Stk.	Mar. 28	4	Do. 4 p.c. Deb..	124—127	..	3 3 0
500,000	100	Aug. 15	12 5/10	New River, New Shares	390—395	..	3 4 6
1,000,000	Stk.	July 31	4	Do. 4 p.c. Deb..	125—130	..	3 1 7
902,300	Stk.	June 14	6	South-wark and { Ord. . . .	175—180	+3	3 6 8
126,500	100	,,	6	7½ p.c. max.	165—170	+3	3 10 7
489,200	Stk.	,,	5	5 p.c. Pref. .	147—152	..	3 5 9
1,019,585	,,	Apl. 12	4	Vauxhall 4 p.c. A Deb.	124—127	..	3 3 0
1,155,066	Stk.	June 14	10	West Middlesex. . .	267—272	+2	3 13 6
200,000	,,	,,	4½	Do. 4½ p.c. Deb. .	138—143	..	3 2 11
200,000	,,	Mar. 14	3	Do. 3 p.c. Deb. .	95—98	..	3 1 3
					*Ex. div.		

the minimum wage agreed to by the Conciliation Board, and 50 per cent. above the 1888 wage. The reduction will have a tendency to ease trade, which is not so good as it was. The falling off is in the foreign trade chiefly; the home demand being well maintained. The prices quoted are: Main 9s. to 9s. 3d. per ton f.o.b. Glasgow, ell 10s. 6d. to 11s. 6d., and splint 10s. 6d. to 10s. 9d. The shipments for the week amounted to 211,311 tons—a decrease of 7198 tons upon the previous week, and of 62,483 tons upon the corresponding week of last year. For the year to date, the total shipments have been 6,462,797 tons—a decrease of 734,024 tons upon the same period of last year.

Water Scheme for the Malton District.—A special meeting of the Malton Rural District Council was recently held to further consider the schemes of water supply for Slingsby and the street villages. Two schemes had been considered by a Committee—one to procure water from Hovingham and the neighbourhood, known as the Wath Beck scheme, and the other from near Gilling, called the Blackdale Plantation scheme. The former would yield 90,000 gallons per day, and cost £7062, equal to a rate of 1s. 4½d. in the pound; and the latter 39,000 gallons, at a cost of £8291, or a rate of 1s. 7¾d. in the pound. The Committee recommended the Wath Beck scheme; and the Council adopted it, with the understanding that Sir William Worsley, the owner of the stream, should be asked to moderate his terms.

Serious Leak in a Huddersfield Reservoir.—Some concern has been caused among the ratepayers of Huddersfield by the news of a leakage in the Butterley reservoir, which it was understood was practically completed, in the Wessenden Valley, Marsden. The Corporation have been unfortunate with this reservoir. Some time after it was commenced, it was found that, owing to an unforeseen fault in the strata, the clay puddle trench would have to be taken down a great deal deeper than was originally expected; and the works have occupied a far longer time, and the cost (£283,785 to the end of July last) has been much greater, than was estimated. The clay embankment is of extraordinary size and strength; but notwithstanding that, after water had been turned into the reservoir a few days ago to the height of 40 feet, or two-fifths of its depth, it was found to escape through the loose strata of the natural sides of the reservoir, passing round the ends of the embankment, and flowing into the stream below. The escape on one side is very slight; but on the other it amounts to 400,000 gallons every 24 hours. It is reported that the Engineers (Messrs. Charles Hawksley and G. H. Crowther, MM.Inst.C.E.) had anticipated that some escape might take place, and had left observation pits when the rest of the work was closed up, in order that any leakage might be detected. They are confident of being ultimately able to make the reservoir water-tight to the full extent of its capacity—400 million gallons—when it will have a surface area of 43 acres, and a maximum depth of 98 ft. 6 in. The top water-level when the reservoir is full will be 700 feet above the sea; and the top of the great impounding embankment across the valley is 111 feet above the bed of the stream.

The Purchase of the Omagh Gas-Works.—The Omagh District Council have instructed their Solicitor to take the necessary steps to obtain a Provisional Order or Act next session, to carry out the purchase of the gas-works, as authorized by the Omagh Gas Act, 1901.

New Issue of Stock of the Swansea Gas Company.—In accordance with the announcement which had previously appeared in the "JOURNAL," Messrs. John M. Leeder and Son, of Swansea, offered for sale last Friday £20,000 of new ordinary 5 per cent. stock and £6000 of 4 per cent. perpetual debenture stock of the Swansea Gas Company. The sale was conducted by Mr. Ernest Leeder, who, after some introductory remarks explanatory of the position of the Company, proceeded to take biddings. The ordinary stock fetched from £113 to £116 per cent., the total amount realized being £22,747 15s.; the debenture stock, £104 to £106 per cent., totalling to £6295—making together £29,042 15s. The average price offered for the ordinary stock was £113 14s. 9d., and for the debenture stock £104 18s. 4d., per £100 of stock.

Chard Water Supply.—There is a prospect of an amicable settlement of the dispute between the Chard Town Council and the Rural District Council, which has prevented the carrying out of works for the improvement of the water supply of the town. It is the desire of the Corporation to obtain a supply from Combe St. Nicholas, which is about three miles away; but they have met with strong opposition from the inhabitants of the village, who contend that there is not sufficient water at the place to supply both their own needs and those of the town. In deference to the wishes of the villagers, the Rural District Council decided some time ago not to allow the highways to be broken up for the laying of pipes, unless the consent of the village was first obtained. A few weeks since, a deputation from the Town Council waited on the Rural District Council, and pointed out the serious consequences of this refusal. Mr. J. Trevor Davies, as the mouthpiece of the Corporation, explained that a Company whose interests would be assigned to the Corporation had purchased land at Combe St. Nicholas, on which a well had been sunk which yielded more than the 90,000 gallons of water a day required at Chard. They were ready to enter into a binding contract that the water supply of the village should not be interfered with, but, on the contrary, should be improved, by the purchase and destruction of certain property which possibly might cause contamination of the water. Mr. Davies added that if the Corporation did not get the assistance they required, they would have to go to Parliament for compulsory powers. In answer to a question, he explained that the Corporation had decided upon this scheme in preference to another which was reported upon, because water could be obtained from Combe St. Nicholas by gravitation, while the other was a pumping scheme, and the difference in the cost of the two was that between a rate of 2d. and one of 1s. in the pound. It was decided, after some discussion, that the Town Clerk of Chard should submit the proposed terms in writing, with a view to their being embodied in a deed; and, in the meantime, notice was given to rescind the resolution by which the consent of Combe St. Nicholas is required to an arrangement between the District Council and the Corporation.

MOST PEOPLE

Take a long time deciding what they want, but having decided, they want it at once.

. . . . .

If it is a "EUREKA" they want, they can have it at once, as we always keep a large Stock of . . . . "EUREKAS" and can deliver the majority of sizes "by return."

JOHN WRIGHT & CO., Essex Works, Aston, BIRMINGHAM.

Scunthorpe Lighted by Gas.—The streets of Scunthorpe were illuminated with gas from the Urban District Council's works for the first time on Monday night last week. In the summer months, the streets are not lighted, and the 1st of September was the date for commencing; but as this fell on a Sunday, the event was postponed for a day.

Theft of a Gas-Meter.—A daring burglary has just been perpetrated at Aylesbury, where thieves broke into a fish shop kept by some Italians. They found very little money about, and so turned their attention to a shilling-in-the-slot gas-meter. Fearing they would disturb the occupants by removing the money-drawer, they cut the supply-pipe and carried away the meter and its contents, leaving the gas escaping. Fortunately, no lives were lost as the result.

Proposed Lighting of Kingstown by Incandescent Gas.—At the last monthly meeting of the Kingstown District Council, Mr. W. G. Barrett proposed the following resolution—"That a Special Committee be appointed to consider, with a view to its modification, the existing arrangement with the Alliance and Dublin Consumers' Gas Company for the public lighting of the town, and to report thereon, with recommendations, to the Council at an early date." In proposing the resolution, he said he did so in order to ascertain upon what terms the Company would light the township by incandescent gas. His purpose in proposing the resolution was that they might have materials to enable them to ascertain the relative cost of lighting by gas and electricity; and when they had them, they could go into the matter with the Company. They had already met Mr. Cotton, who had stated that the Company would meet them very favourably. He was convinced that it would cost them about three times more for electric light than for gas. The proposition was agreed to.

Projected Alterations at the Wellingborough Gas-Works.—At the meeting of the Wellingborough Gas Company on the 26th ult., the Directors reported an increase of nearly 20 per cent. in the quantity of gas sold in the six months ending the 30th of June. The continued growth of the Company's business has, of course, necessitated constant enlargement of the works. A further considerable extension being now needed, the Company's Engineer (Mr. J. T. Lewis) recently submitted a report to the Directors, in which he showed that a great saving in the cost of manufacture could be effected if the works were in communication with the railway; but as the expense of a connecting line with the present establishment would be prohibitive, he advised that if a suitable site could be obtained adjoining the railway, it would pay the Company to remove thereto the manufacturing portion of the plant, and retain the present works for purification and storage. The Directors are satisfied with the soundness of the Engineer's views, and have therefore entered into a provisional contract for the purchase of a piece of land adjoining the loop line of the Midland Railway. Parliamentary powers will, however, be required before works can be erected on this site; and the Directors will ask the shareholders, at a special meeting which has been called, to pass a resolution giving them authority to apply to the Board of Trade for a Provisional Order conferring the necessary powers.

Carlisle Gas Workers' Wages.—At the meeting of the Gas Committee of the Carlisle Corporation last Wednesday, it was decided to increase the wages of the stokers 3d. per shift.

Harrow and Stanmore Gas Company.—At the half-yearly general meeting of this Company yesterday, the accounts presented for the six months ending June 30 showed that the revenue in this period had been £10,878, and the expenditure £7822; leaving a sum of £3056 to be carried to the profit and loss account, the balance on which was £3811. Dividends at the rates of £8, £7, £5 12s., and £6 per cent. per annum, all less income-tax, were declared. The business of the Company continues to progress.

Ottoman Gas Company, Limited.—The Directors of this Company, in their report for the half year ended June 30, state that the gas rental for that period amounted to £11,091, as against £10,009 in the same period of last year. The net profit is £2098. The amount standing at the credit of profit and loss account is £3341; and out of this the Directors recommend that a dividend at the rate of 7 per cent. per annum on both classes of shares should be paid. This will absorb £2625, and leave a balance of £716 to be carried forward.

Overhead Wire Dangers.—Southampton has just had an experience of the dangers connected with overhead electric wires, similar to that of Liverpool. One of the feed-wires supplying the current to the Corporation tramways trolley wire became fused. The insulating material burned, and then the wire snapped. The accident happened at the most crowded part of the system and at a busy time; but fortunately only one casualty resulted. The wire caught a boy across the face, and felled him to the ground, causing serious injury to one eye, the sight of which it is feared he will lose.

Leeds Gas Workers and their Wages.—The application from the gas workers of Leeds for an advance in wages of 6d. per day came before a full meeting of the Corporation Gas Committee last Friday—Alderman Lowden (the Chairman) presiding. On a previous occasion, the Committee intimated their willingness to accede to the request on condition that the stokers should deal with an additional 6 cwt. of coal a day, that the wheelers remove an extra ton, and that the firemen consent to look after an additional fire. The men contend that to do this is a physical impossibility. A deputation from the men, headed by Mr. W. Wood, had a long interview with the Committee. It was pointed out by the Chairman and others that the same amount of work as the Committee asked for was being done in some other towns in the North of England; and that though wages were rather higher in one or two of these places, the amount of labour performed was much greater. In Leeds the cost of carbonizing per ton was actually higher. On behalf of the men, it was stated that stokers and coal wheelers in Leeds worked under harder conditions, and suffered inconveniences not experienced in other places, particularly in regard to the distances the men had to cover in the works. The result of the interview was that it was mutually agreed that a Sub-Committee should visit the works, especially with a view to seeing the conditions of labour, so as to make a comparison with what is done elsewhere.

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WELSBACH INCANDESCENT GAS-LIGHT CO., Limited,

PUBLIC LIGHTING DEPARTMENT, YORK STREET, WESTMINSTER, LONDON, S.W.

Fylde Water Board.—The second annual report of this Board has been issued. It is stated that considerable alterations have been made in the system of keeping the accounts, in order to meet the requirements of the Local Government Board. The financial result of the first complete year is highly satisfactory to the Board. After setting aside £9373 as the contribution to the sinking fund (including loans repaid), and the payment of £28,601 in dividend and interest, the surplus revenue balance was increased during the year by £2603; making the balance in March last £35,440. This has been used mainly for the general purposes of the undertaking; leaving with the Treasurer a cash balance of £2845. The Board propose to devote about £1000 a year out of the revenue for the renewal of water-mains.

The Largest Water-Works Boring in England.—It will no doubt be remembered that up to the present time the record for large water borings has been held by Gainsborough, in Lincolnshire; and it is therefore not unnatural to find that the first attempt to beat this record is to be made by the capital city of that county. The Corporation of Lincoln, having been advised by many eminent geologists as to the feasibility of obtaining an additional supply of water from the new red sandstone, consulted Mr. Percy Griffith, of Westminster, who had acted for the Gainsborough District Council. Specifications having been prepared, tenders were invited for a boring 2176 feet deep, lined with 30-inch tubes for a depth of 400 feet, and terminating not less than 12 inches diameter. Seven tenders were received, the amounts ranging from £21,645 down to £11,970; and the Corporation, on the advice of their Engineer, have accepted that of Messrs. Charles Chapman and Sons, Limited, of Salford, amounting to £14,605. The time allowed for the completion of the work is four years; but it is confidently anticipated that, by taking ample precautions against accidents, a much shorter period will suffice.

Incandescent Gas v. Electric Light.—As inquiries on the subject of the comparative cost of gas and electric lighting occasionally reach us, any contribution to the subject should be welcome to our readers. We therefore reproduce from the "North Middlesex Chronicle" of the 31st ult., the following letter, which contains some interesting particulars: "Sir, if you would publish the secret of how the electric current supplied in Islington can be consumed at as cheap a rate as gas, you would confer an enormous benefit on the parish, for in a very short time our expensive Electric Light Department would be producing handsome profits. I have tested the two lights, with the following result: Two incandescent gas-burners, burning for twelve months, cost (120-candle power) £2 6s. 1d.; four 16 and eight 8-candle power incandescent electric lights, burning for twelve months—exactly the same number of hours as the gas—cost (128-candle power) £10 9s. 6d. Thus, allowing a good margin for the saving in cleansing and redecorating, the electric light is about three times the price of gas. I am able to give these figures as a just and fair test for the twelve months, not having had any other lights running on the meters." The writer of the letter is Mr. J. Wyman, 3, Electric Parade, Seven Sisters' Road.

Increase in the Price of Gas in York.—The Directors of the York United Gas Company have raised the price of gas 4d. per 1000 cubic feet—advancing the scale of charges, according to consumption, from 1s. 11d. to 2s. 3d., from 1s. 9d. to 2s. 1d., and from 1s. 8d. to 2s.—to take effect from the end of the present quarter.

Acetylene Gas for Outdoor Lighting.—An interesting experiment was made a few evenings since at the Alexandra Dock, Liverpool, in the presence of a number of commercial gentlemen, with acetylene gas as produced by the Manchester Acetylene Gas Company. Special lamps have been made, of a portable character, by which a strong and brilliant light can be given at what is claimed to be a very low cost. The feature of the arrangement is the absolute freedom from danger attending the type of generator used; and this was favourably commented upon by many present.

Incandescent Gas v. Electric Lighting.—At the monthly meeting of the Waterloo District Council on Monday last week, the minutes of the General Purposes Committee showed that the Surveyor had read a report on the rearrangement of the lighting of the district by incandescent gas and incandescent electricity respectively, and that it was decided that an application should be made to the Local Government Board for sanction to borrow £2000 for the former purpose. Mr. G. D. Killey spoke in favour of the scheme. He said he thought it must be a satisfaction to the community at large that the question was now definitely settled. He was perfectly convinced that the lighting of the district by the system they were going to adopt would be acceptable, and would involve the outlay of a very small sum as compared with the cost of electric lighting, taking into account the capital expenditure. Mr. Wyatt said that in every town he had visited the incandescent light was in use. He supported the decision of the General Purposes Committee; and the minutes were adopted.

Studley Water Supply.—The proposed scheme for water supply at Studley, near Alcester, was recently debated at some length at a well-attended meeting of the parochial electors, presided over by the Vicar (the Rev. F. J. Thompson). The present position seems to be that negotiations are in progress between the Alcester Rural District Council and the East Worcestershire Water Company, with the view of a water supply being obtained for Studley, in conjunction with Astwood Bank, from the Company, who have offered the water in bulk at the rate of 8d. per 1000 gallons for a minimum daily consumption of 50,000 gallons, and for any further quantity that might be agreed upon at the rate of 7d. per 1000 gallons. The Company decline to entertain the question of laying the mains at their own expense; but they are prepared to apply for an Act of Parliament for the extension of their district. In the course of the discussion, it was pointed out that, should the Council lay the mains, the cost would be spread over the rural as well as the urban portion of the parish, which it was contended would be unjust. Eventually Mr. Oakley proposed that the meeting should be adjourned until an estimate of the probable cost had been received. As an amendment, Mr. E. Fenn (a member of the Alcester District Council) moved that the meeting objected to the scheme in its present form; and this was carried by 24 votes to 22.

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SWINDON (New Swindon Gas Co.)	120,000
SALTLEY, BIRMINGHAM (Second Contract)	2,000,000
WINDSOR ST., BIRMINGHAM (Second Contract)	2,000,000
HALIFAX	1,000,000
TORONTO	250,000
OTTAWA	250,000
LINDSAY (Remodelled)	125,000
MONTREAL	500,000
TORONTO (Second Contract; Remodelled)	2,000,000
BELLEVILLE	250,000
OTTAWA (Second Contract)	250,000
BRANTFORD (Remodelled)	200,000
ST. CATHERINES (Remodelled)	250,000
KINGSTON, PA.	125,000
PETERBOROUGH, ONT.	250,000
WILKESBARRE, PA.	750,000
ST. CATHERINES (Second Contract)	250,000
BUFFALO, N.Y.	2,000,000
WINNIPEG, MAN.	500,000
COLCHESTER (Second Contract)	300,000
YORK	750,000
ROCHESTER	500,000
KINGSTON, ONT.	300,000
CRYSTAL PALACE DISTRICT	2,000,000
DULUTH, MINN.	300,000
CATERHAM	150,000
LEICESTER	2,000,000
ENSCHEDE (HOLLAND)	150,000
BUENOS AYRES (RIVER PLATE CO.)	700,000
BURNLEY	1,500,000
KINGSTON-ON-THAMES	1,750,000
ACCRINGTON	500,000
TONBRIDGE	300,000
STRETFORD	500,000
OLDBURY	300,000
TODMORDEN	500,000
SALTLEY, BIRMINGHAM (Third Contract)	2,000,000
YORK (Second Contract)	750,000
ROCHESTER (Second Contract)	500,000
NEWPORT (MON.)	250,000
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Gas-Works Improvements at Teignmouth.—The scheme of Mr. Gray, the new Gas Manager at Teignmouth, for the improvement of the works is to be carried out. At a meeting of the District Council last Tuesday, the Gas Committee reported that they had the matter under consideration, and recommended the Council to obtain power to borrow £3000 for the purpose of carrying out the improvements. Mr. Banbury, who moved the adoption of the report, said it was a large expenditure, but the Committee hoped the effect of it would be to put an end to their troubles, and convert the undertaking from a financial millstone into a profitable concern. The increased revenue from the residuals after the alterations were effected, would pay interest on the proposed loan. The Council adopted the report.

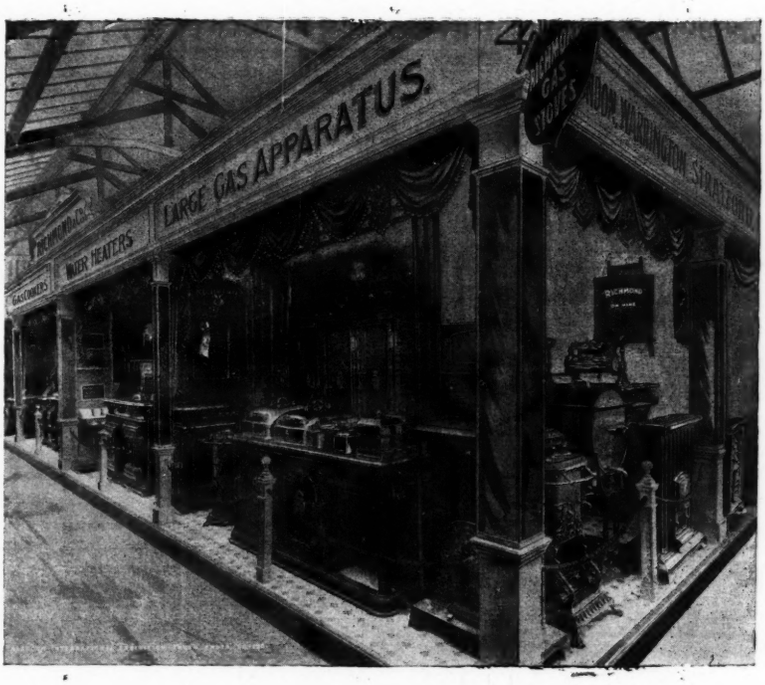
New Water-Works for Westbury (Wilts.).—The new water-works at Westbury were opened last Wednesday. The scheme was prepared by Mr. W. H. Stanley, of Trowbridge; and the cost of construction has been about £13,000. The pumping-station is situated on the Bratton Road, about a mile from the town. It is a red brick building, with Bath stone dressings, and contains a store-room and repairing-shed. The well, from which adits have been driven, is 50 feet in depth, and has a protective area of 1000 feet. Two of Tangye's gas-engines, which are duplicated, supply the motive power; and the water is lifted through a 7-inch main a height of 222 feet to a reservoir situated at the bottom of Long River, which will contain two days' supply; the storage capacity being about 170,000 gallons, while that of the well and adits is 47,000 gallons. From the reservoir the water flows through 7½ miles of cast-iron mains, not only to Westbury, but to Westbury Leigh and Dilton Marsh. The district is well supplied with hydrants, water-pillars, &c.; and the pressure seems to be good throughout. The laying of the mains was done by the Rural District Council, under direct control; but the work at the pumping-station, well, and reservoir was carried out by Messrs. Wills and Sons, of Bath.

Leigh and the Golborne Gas Bill.—At a meeting of the Golborne Gas Committee of the Leigh Town Council on the 29th ult., letters were read from Messrs. Lewin, Gregory, and Anderson (Parliamentary Agents), stating that the Golborne Gas Bill, 1901, as amended by the Committee of the House of Lords by the inclusion therein of a clause to enable the Corporation to remove any pipes and apparatus belonging to them in Golborne, received the Royal Assent on the 9th ult. It was resolved that the Gas Manager be instructed to take the necessary steps for the immediate removal of the plant indicated. To a meeting of the Corporation Finance, Estate, and Parliamentary Committee next day, the Golborne Gas Committee submitted the following accounts for payment: Messrs. Lewin, Gregory, and Anderson (Counsel's fees, &c.), £700; Messrs. Stevenson and Burstal (professional fees, &c.), £125 12s. 2d.; Mr. S. Glover (professional fees, &c.), £61 12s. It was resolved that the Gas Committee be requested to appoint five of their members to form, with five members of this Committee, a Sub-Committee to take into consideration the expenditure incurred by the Golborne Gas Committee, and that this Sub-Committee report as to what expenditure incurred by that Committee has already been paid out of the gas fund.

The Projected New Water-Works for Leeds.—The new territory acquired by the Leeds Corporation—an extensive tract of moorland between Masham and Middlesmoor—was recently visited by the Water Committee, in order to see and judge of its value as a gathering-ground, and to inspect the sites of the proposed reservoirs. The party were conveyed by train to Masham, where they were met by Mr. T. Hewson, the City Engineer. They drove thence to Colsterdale, some seven miles distant, where is the site of one of the three reservoirs to be constructed. A deep valley will be utilized for the purpose, and the most important work will be the construction of an embankment. This will be 610 yards in length and 110 feet in height from the bed of the stream running through. This will provide storage for 1852 million gallons—much more than that of the Eccup reservoir, the capacity of which is about 1400 million gallons. The gathering-ground which will supply Colsterdale is 8327 acres. The party next drove to Leighton, some 4 miles from Masham, where is the site of another reservoir, which will have an area of 105 acres, and require an embankment 480 yards in length and 110 feet in height. The construction of this reservoir will entail a large expenditure; but it will be of great advantage to the city, inasmuch as it will serve not only for compensation purposes, but for the storage of the surplus waters of Colsterdale. And it will be possible to send by gravitation to Swinsty, in the Washburn Valley, where the city's other gathering-ground is situated, all the waters derived from both Leighton and Colsterdale. The site of the third reservoir is at Carlesmoor, near Kirkby Malzeard.

Plymouth Water Supply.—An inquiry was held at Plymouth on Tuesday last by Mr. W. O. E. Meade-King, respecting an application by the Town Council for sanction to a loan of £91,000 for works authorized by the Plymouth Corporation Water Act, 1893, and for the extension and improvement of the works. The Town Clerk explained that the parliamentary estimate of the cost authorized by the Act of 1893 was £150,000; but this had been considerably exceeded. They put down £1000 for parliamentary expenses; but the Bill was strenuously fought, and they came to £7000. In the construction of the Sheepstor dam in connection with the Burrator reservoir, though the dam was only 13 feet high, they had to go down 102 feet for the foundation; and instead of the cost being £3993, as estimated, it was £23,937. They also took advantage of the power given in the Act to increase the height of the reservoir by 3 feet; and this involved an additional £4000. The reconstruction of the Hartley reservoir, which formerly leaked like a sieve, cost £7290; and blocking the leat, which was done to make it water-tight, required £5082. Of the remainder, £6877 was spent on the renewal of old mains, and £29,700 on the extension of mains in new districts. Mr. Frank Howarth, the Water Engineer, and other officials, gave evidence respecting the various works which had been carried out. The Town Clerk (Mr. J. H. Ellis) explained, in answer to the Inspector, that the only amount remaining unexpended under the Act was £14,442, the estimated cost of certain duplicate mains. The leat, though not now used for conveying water for consumption, remained as an independent watercourse, and might be again brought into service in the event of a breakdown of the mains or a stoppage of water from other causes.

Glasgow Exhibition.



Lighting and Heating Section.

Diminishing Water Stores in Lancashire and Yorkshire.—The stock of water in the reservoirs of the Manchester Corporation went down considerably last week. On Tuesday the reserve was 1414 million gallons, or equal, on the present reduced basis, to rather more than 40 days' supply. Next day it was 1385 millions; and on Thursday, 1353 millions—the latter being about 33 days' supply. There was no rain in the Longdendale Valley on that day, and though some 6 million gallons of water came in from streams, the stock on Friday was equal to only 32 days' supply. On Thursday, the reserve at Stockport was down to 27, at Halifax to 25, and at Bradford to 20 days' supply.

Maryport Water Supply.—At the last meeting of the Maryport District Council, it transpired that the Engineer (Mr. Ralph Stokoe) had lately reported to the Water Committee that he had had an inspection made of the whole of the district supplied with water, and new washers put on taps to the number of 213, and that the quantity of water saved would be about 9000 gallons per day; also that for the past two months there had been no difficulty in keeping the service reservoir filled, owing to the falling off in the consumption at the Solway Iron-Works. It is quite clear now that the alarm recently felt in regard to a probable scarcity of water was not caused by the pipes being too small, as was suggested, but owing to a deliberate waste of water by consumers all over the district. The measures adopted by Mr. Stokoe will, it is believed, obviate the necessity for the proposed extension of the water-works, at a heavy cost.

The difficulty of carrying on successfully a growing engineering business in London has caused the Pulsometer Engineering Company, Limited, to remove their works and offices from Nine Elms, S.W., to the Nine Elms Iron-Works, Reading. The offices and show-room at No. 63, Queen Victoria Street, E.C., are, however, retained.

The tender of Messrs. Willey and Co., of Exeter, has been accepted for improvements at the St. Mary Church Gas-Works, for £4847; and that of Mr. G. R. Hislop for the supply and fixing of retorts and mountings in the five ovens on his regeneration system, for £807.

The Welsbach Incandescent Gas-Light Company, Limited, have just issued their catalogue for the season 1901-2. Its size has been increased, and it presents a large variety of new fittings and glass of very artistic designs. In view of the keen competition existing between the incandescent gas system and the electric light, the Company have had prepared a "Comparison of Cost" sheet, based upon electricity at 5d. per Board of Trade unit and gas, at 3s. per 1000 cubic feet, used with their burners; and a supply of them can be had on application.

At the recent annual inspection of the Northampton Water-Works by the Water Committee and the Engineer (Mr. F. Tomlinson), the first works visited were the well and pumping-station on the Billing Road, where some considerable improvements have been effected. An interesting feature of these works is that this source of water was utilized for the supply of the town at a very early date, as testified by the following inscription upon a stone in the building: "Conduit head, 1479. Repaired, 1542. Pipes laid open, 1716. New pipes, 1784. Rebuilt by Corporation, 1811."

At a certain provincial gas-works it is the practice, whenever anything in connection with the gas supply requires attention, for the inspector sent to have a printed form given him, at the bottom of which is a space for a report setting forth the nature of the difficulty. Recently one of these papers came in having a remark which caused the Engineer a moment's consideration. The words "Drike Road" appeared. This road he could not call to mind; but, on reflecting for a moment, the words seemed to him to be a somewhat free rendering of the familiar cause of a stoppage—"dry corrode." Many of our readers are only too well acquainted with the road under its original title.

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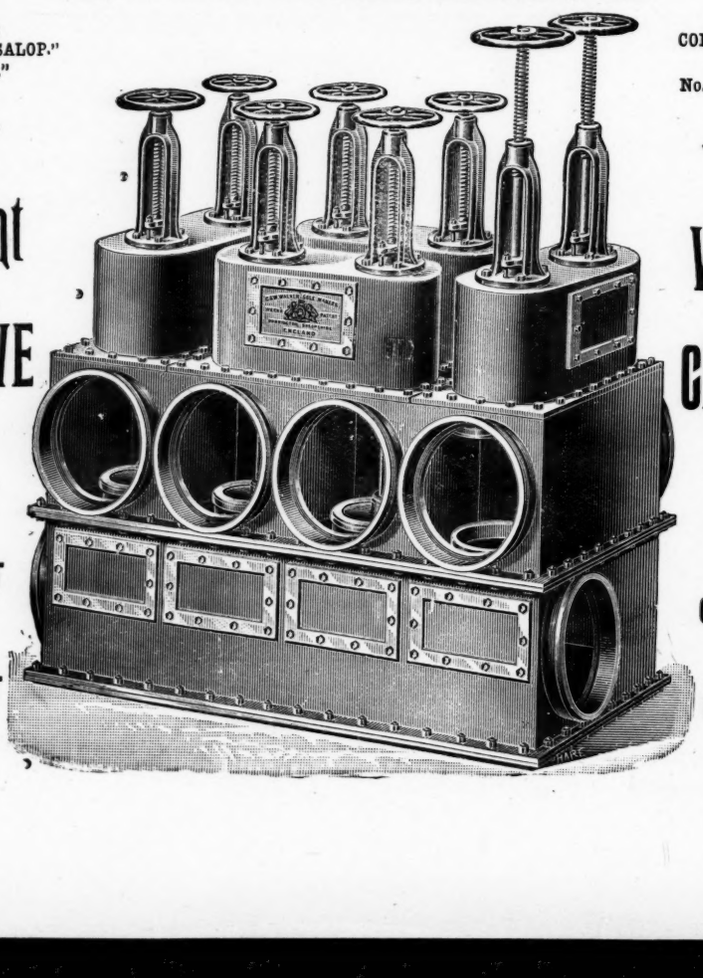

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Council Chambers, Padiham,
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Talent, energy, and determination are the characteristics required; for these the Company are prepared to pay. Remuneration may be by Salary entirely, or Salary and a percentage of the profits earned.

Apply, in writing (in confidence), giving full Particulars of past Experience, Age, Salary, with References, to the above COMPANY, No. 20, Park Row, LEEDS, marked "Gas Engineer."

OXIDE OF IRON OF FINEST QUALITY.

BALE'S Special Fire Cement should be used to keep Retorts, Furnaces, &c., in good repair during the heavy Winter Work.

Send for full Particulars to
BALE & CO., 120 & 121, NEWGATE STREET, LONDON, E.C.
Telegrams: "BOGORE, LONDON."
Telephone "277 HOLBORN."

GAS PLANT for Sale—I can always offer NEW and SECOND-HAND GAS APPARATUS, including Retorts and Fittings, Condensers, Exhausters, Scrubbers, Washers, Purifiers, Gasholders, Tanks, Valves, Connections, &c. Also a few COMPLETE WORKS. Compare Prices and Particulars before ordering elsewhere.

J. F. BLAKELEY Gas Engineer, Thornhill, DEWSBURY.

TO BE SOLD—

GASHOLDER (with Wrought-Iron Tank), 30 ft. by 12 ft. Cable Guided. New in 1895.
CENTRE-VALVE, 15 in. diameter, by Walker, for Four Purifiers.
Four PURIFIERS, 10 feet square, in line, with Planed Joints, Walker Centre-Valve, Covers, and Traversing Crab Lifting Gear. Will be refixed equal to new.

Write J. WRIGHT, Bridge House, BLACKFRIARS, E.C.

FOR SALE.

THE Ipswich Gaslight Company have FOR SALE two Armstrong's HYDRAULIC CRANES, with Pumping-Engine.

These Cranes are in good working order, and have been constantly in use for unloading Coals into the Company's works, but are now being displaced by larger Cranes.

Further Particulars may be had on application to the SECRETARY, Carr Street, IPSWICH. Inquiries invited.

TENDERS invited for 200 £10 Shares, fully paid, in the Firm of Kempson and Co., Limited, Tar and Ammonia Distillers, Pye Bridge, near Alfreton.

Tenders to be addressed to No. 3738, care of Mr. King, 11, Bolt Court, FLEET STREET, E.C.

FARNWORTH AND KEARSLEY GAS COMPANY.

TENDERS FOR COAL AND CANNEL.

THE Directors of this Company invite TENDERS for the Supply of COAL and CANNEL for delivery between October, 1901, and the 31st of July, 1902.

Forms of Tender and Specification can be had from the undersigned.

Sealed Tenders to be addressed to the Chairman, J. W. Watkinson, Esq., and to be delivered on or before the 25th day of September.

THOS. LEA SHEPPARD,
Manager.

Gas Offices, Farnworth,
Sept. 6, 1901.

TO TAR DISTILLERS AND OTHERS.

THE Gas Committee of the Bradford Corporation are prepared to receive TENDERS for the purchase of their surplus TAR for the Year ending September 30, 1902.

Form of Tender, with any further Information required, may be had on application to Mr. C. Wood, Gas Engineer, Town Hall.

Sealed Tenders, endorsed "Tender for Tar," to be sent to me on or before Thursday, the 19th of September next.

The highest or any Tender will not necessarily be accepted.

FREDERICK STEVENS,
Town Clerk.

Town Hall, Bradford,
Aug. 30, 1901.

TYLDESLEY-WITH-SHAKERLEY URBAN DISTRICT COUNCIL.

THIS Council invite Tenders for the supply and erection, at the Gas-Works, Tyldesley, of an IRON SHED with Corrugated Iron Roof, for the Coal-Store.

Further Particulars as to same may be had on application to the Engineer, Gas-Works, Tyldesley.

Tenders (on Authorized Forms only, which will be supplied by the Gas Engineer on application), sealed and endorsed "Tender for Coal Shed," to be addressed to the undersigned, and delivered at the Council Offices, Tyldesley, not later than the 23rd of September inst.

The Council do not bind themselves to accept the lowest or any Tender.

By order,
WM. J. MATTHEWS,
Clerk.

Council Offices, Tyldesley,
Sept. 5, 1901.

COUNTY BOROUGH OF WEST BROMWICH.
(GAS DEPARTMENT.)

TENDERS FOR BENZOL.

THE Gas Committee invite Tenders for the supply of 18,000 Gallons of Purified 90 per cent. BENZOL, suitable for gas enrichment purposes, to be delivered free at their Gas-Works as may be required from the 1st of December, 1901, to the 31st of March, 1902.

Information relating to Quality, &c., may be obtained from the Engineer (Mr. Thomas Glover), at the Gas-Works.

Tenders, endorsed "Tender for Benzol," to be sent to me not later than Sept. 19.

The Gas Committee do not bind themselves to accept the lowest or any Tender.

THOS. HUDSON,
Secretary.

Town Hall, West Bromwich,
Sept. 4, 1901.

BOROUGH OF LEIGH.
(GAS DEPARTMENT.)

THE Gas and Water Committee of the above Corporation invite TENDERS for the surplus TAR for the year ending September 30, 1902. Approximate quantity, 900 tons.

Forms of Tender, and any further Particulars, may be obtained from the Manager, Mr. J. Foster, Gas-Works, Leigh, Lancs.

Sealed Tenders, endorsed "Tender for Tar," to be sent to me the undersigned not later than twelve o'clock noon on Saturday, the 21st day of September, 1901.

By order,
PEREGRINE THOMAS,
Town Clerk.

Town Hall, Leigh, Lancs.,
Sept. 6, 1901.

EAST LONDON WATER-WORKS COMPANY.

NOTICE is Hereby Given, that the HALF-YEARLY GENERAL ASSEMBLY of the Proprietors will be held at the Company's Offices, St. Helen's Place, Bishopsgate Street, E.C., on Thursday, the 3rd of October, 1901, at Twelve o'clock noon precisely, pursuant to Act of Parliament.

The TRANSFER BOOKS in respect of the ORDINARY STOCK WILL BE CLOSED from the 19th of September inst. to the 9th of October, both days inclusive, and RE-OPENED on the 10th of October, on which day the Dividends on this Stock will be payable.

By order,
I. A. CROOKENDEN,
Secretary.

15a, St. Helen's Place,
Bishopsgate, E.C., Sept. 7, 1901.

OTTOMAN GAS COMPANY, LIMITED.

NOTICE is Hereby Given, that the ORDINARY HALF-YEARLY GENERAL MEETING of the Shareholders of this Company will be held at 9, Queen Street Place, Cannon Street, E.C., on Tuesday, Sept. 17, 1901, at Half-past Two o'clock precisely, to receive the Report of the Directors and Statement of Accounts for the Half Year ended the 30th of June last, to declare a Dividend, and for General Purposes.

The TRANSFER BOOKS WILL BE CLOSED from Sept. 10th to 17th, both days inclusive.

By order of the Board,
THOMAS GUYATT,
Secretary.

9, Queen Street Place, Cannon Street,
London, E.C., Sept. 3, 1901.

BRITISH GASLIGHT COMPANY, LIMITED.

NOTICE is Hereby Given, that the ORDINARY HALF-YEARLY GENERAL MEETING of the Proprietors of this Company will be held at this Office on Wednesday, the 25th inst., at Twelve o'clock precisely, to transact the usual Business, to declare a Dividend for the Half Year ended the 30th of June last, to elect Two Directors in the place of those who go out by rotation, and to appoint Two Auditors. The retiring Directors and the present Auditors are eligible for re-election.

Notice is Hereby also Given, that the TRANSFER BOOKS of the Company WILL BE CLOSED on the 14th and RE-OPENED on the 26th inst.

By order of the Court of Directors,
H. B. CHAMBERLAIN,
Secretary.

Chief Office: No. 11, George Yard,
Lombard Street, London, E.C.,
Sept. 4, 1901.

WOKING DISTRICT GAS COMPANY, LIMITED.

Re WOKING DISTRICT GAS ORDER, 1901.

SALE BY TENDER OF
1000 ORDINARY SHARES OF £5 EACH
RANKING FOR DIVIDEND UP TO 7 PER CENT.

THE Directors of the above Company pursuant to the above Order, will be prepared to receive sealed TENDERS for

1000 ORDINARY SHARES OF £5 EACH

(ranking for Dividend up to 7 per cent.) of the above Company, such Shares being a portion of the additional Capital of £20,000 authorized by the above Order.

The Minimum price is £5 per Share, and the highest Tenderer or Tenderers will be declared the Purchaser or Purchasers of the Shares tendered for by him or them.

The Tenders will be received on the 18th of September instant, and notice of acceptance will be given on the 21st of September instant.

Particulars and Conditions of Sale, together with the Form of Tender, can be obtained of the Company's Bankers, the Capital and Counties Bank, Limited, 39, Threadneedle Street, E.C., or at the Offices of the Company, 5 and 6, Great Winchester Street, Old Broad Street, London, E.C., where the Provisional Order can be inspected.

By order,
B. DENNETT HOLROYD,
Secretary.

5 and 6, Great Winchester Street,
Old Broad Street, London, E.C.,
Sept. 4, 1901.

SALES BY AUCTION OF GAS AND WATER STOCKS AND SHARES.

MR. ALFRED RICHARDS begs to notify that his AUCTIONS of STOCKS and SHARES in London, Suburban, and Provincial Gas and Water Companies are held PERIODICALLY, at the Mart, Tokenhouse Yard, E.C.

He also undertakes the issuing by AUCTION of GAS and WATER STOCKS and SHARES under Parliamentary Powers.

Terms for issuing such Capital, and also for including Gas and Water Stocks and Shares in these periodical Sales, can be obtained on application at Mr. ALFRED RICHARDS' OFFICES, 18, FINSBURY CIRCUS, E.C.

CITY OF BRADFORD.

THE Gas Committee of the Bradford Corporation are prepared to receive TENDERS for the supply of the following MISCELLANEOUS GOODS required in their several Departments during a period of One Year ending September 30, 1902:—

	Probable quantity required.
Wet and Dry Gas-Meters	
Pipes and Castings	
Wrought-Iron Steam Tubing	
Best Merchant Iron and Steel	20 Tons.
Wrought-Iron Grate Bars	6 Tons.
Charging Shovels	50 Dozen.
Oxide Wiskets	25 Dozen.
Cotton Waste	40 Cwt.
Best Engine Oil	1200 Gallons.
Common Engine Oil	1500 Gallons.
Cylinder Oil	500 Gallons.
Tarred Gaskin	40 Cwt.
Brass Main Gas-Cocks	120 Dozen.
Weed Brooms	40 Dozen.
Best Lime	150 Tons.
Copper Lamps	
Lamp Irons	

Samples may be seen at the Mill Street Gas-Works, where Forms of Tender and any further Information required may be obtained.

Persons tendering must give an assurance that they have paid to their workmen for Three Months preceding date of Tender not less than the minimum Standard Rate of Wages, and undertake to continue to pay during the Contract the said Rate of Wages.

Tenders, endorsed "Tender—Miscellaneous Goods," to be sent to me not later than Thursday, Sept. 19.

The lowest or any Tender will not necessarily be accepted.

FREDERICK STEVENS,
Town Clerk.

Town Hall, Bradford,
Aug. 30, 1901.

BOROUGH OF PORTSMOUTH WATER-WORKS COMPANY.

IMPORTANT SALE OF A FURTHER ISSUE OF NEW SHARES IN THE ABOVE SUBSTANTIAL AND OLD-STANDING COMPANY.

HALL, PAIN, & GOLDSMITH beg to announce that they are favoured with Instructions from the Directors of the above-named Company to SELL BY PUBLIC AUCTION, at their Estate Sale Rooms, 57, Commercial Road, Portsmouth, on Thursday, October 3, 1901, at Seven o'clock in the Evening, the Eighth portion of the New Issue, authorized under "The Borough of Portsmouth Water Order, 1898," comprising

1500 SHARES OF £5 EACH

(fully-paid), forming part of the New Ordinary Capital Authorized under such Order.

The Auctioneers beg to call the special attention of Capitalists, Investors, and others to this very favourable opportunity of securing Shares in such a thoroughly sound Local Company.

The Shares will be Sold free of any Charges, Fees, or Expenses whatever to the Purchaser.

Full Particulars and Conditions of Sale may be obtained, with any further Information, from the Secretary of the Company, J. L. WILKINSON, Esq., F.I.S., at the Company's Offices, Commercial Road, PORTSMOUTH; or of the AUCTIONEERS, 57, Commercial Road, PORTSMOUTH.

ROBERT MARSHALL,
CANNEL COAL MERCHANT,
97, WELLINGTON STREET, GLASGOW.

Prices and Analysis of all the Scotch Cannels on Application.

NEWBATTLE CANNEL.
Highest Results in Gas, & Excellent Coke.

QUOTATIONS ON APPLICATION TO
THE LOTHIAN COAL COMPANY,
LIMITED,
NEWBATTLE COLLIERIES,
DALKEITH, N.B.

HYDRAULIC BLOWER
For blowing Air into Gas Purifiers for the purpose of
REVIVIFYING THE FOULED OXIDE.
Full Particulars on application.
LUXWERKE LUDWIGSHAFEN AM RHEIN.

TROTTER, HAINES, & CORBETT, LIMITED,
Brettell's Estate
FIRE-CLAY & BRICK WORKS,
STOURBRIDGE.
Manufacturers of GAS-RETORTS, GLASSHOUSE FURNACE & BLAST-FURNACE BRICKS, LUMPS, TILES, and every description of FIRE-BRICKS.
Special Lumps, Tiles, and Bricks for Regenerative and Furnace Work.
SHIPMENTS PROMPTLY AND CAREFULLY EXECUTED.
LONDON OFFICE: R. CULL, 84, OLD BROAD STREET, E.C.

THOMAS DUXBURY & CO.,
16, DEANSGATE, MANCHESTER.
GAS ENGINEERS' AGENTS AND CONTRACTORS FOR
Meters, Fire-Clay Goods, Oxide of Iron, and all other Gas Apparatus. Retort Carbon purchased.
Inquiries Solicited.
Telegrams: "DARWINIAN, MANCHESTER." Telephone 1806.

PRICE'S COKE & COAL BARROW

effects a great saving of time, labour, and expense.
For Particulars Price, &c., apply to Mr. EDWARD PRICE, "Langley," Wyke Avenue, WORTHING.
Prices are Reduced.

HARDMAN & HOLDEN, LD.
ESTABLISHED 1820.
SULPHURIC ACID.
MADE from Spent Oxide (free from Arsenic) and of excellent Purity. Specially prepared for Sulphate of Ammonia Manufacturers.
Works: BLACKBURN; Miles Platting and Clayton, MANCHESTER.
Head Office: Miles Platting, MANCHESTER.
Inquiries Solicited.

JAMES OAKES & CO.
ALFRETON IRON-WORKS, DERBYSHIRE,
AND
Wenlock Iron Wharf, 21 & 22, Wharf Road,
CITY ROAD, LONDON, N.,
Manufacture and keep in Stock at their Works (also large stock in London)
PIPES and CONNECTIONS, 1½ to 48 inches in diameter, and make and erect to order RETORTS, PURIFIERS and TANKS, with or without planed joints, COLUMNS, GIRDERS, SPECIAL CASTINGS, &c., required by Gas, Water, Railway, Telegraph, Chemical, Colliery, and other Companies.
NOTE.—Makers of HORSLEY'S PATENT SYPHONS. These are cast in one piece, without Chaplets; doing away with Bolts, Nuts and Covers, and rendering Leakage impossible.

THOMAS TURTON AND SONS, LIMITED,
SHEAF WORKS, SHEFFIELD,
MANUFACTURERS OF
FILES OF BEST QUALITY
FOR ENGINEERS.
STEEL OF ALL DESCRIPTIONS.
SCREW STOCKS, TAPS AND DIES,
SPANNERS, RATCHET BRACES, LIFTING JACK
ANVILS, VICES,
AND ENGINEERS' TOOLS GENERALLY.
LONDON OFFICE:
90, CANNON STREET, E.C.

COKE-BREAKERS,

PRICES REDUCED.

(THOMAS & SOMERVILLE'S PATENT)

With Elevators and Conveyors worked by Steam or Gas Engine.

GEORGE WALLER & CO.

165, QUEEN VICTORIA STREET, E.C.;

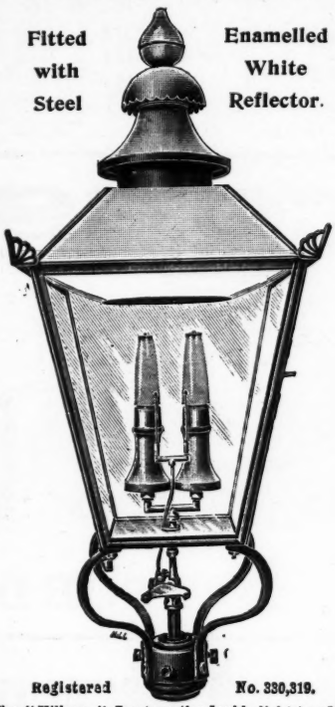
And at STROUD, GLOUCESTERSHIRE.

THE

"KILBURN" LANTERN.

Fitted with Steel

Enamelled White Reflector.



Registered No. 330,319.

The "Kilburn" Lantern (for double lights) and the "St. Albans" Lantern have been adopted for lighting the Town of St. Helens.

H. GREENE & SONS, LTD.

Late of Cannon Street,

Works and Show Rooms:

19, Farringdon Road, E.C.

Registered Offices:

36, Mark Lane, E.C.

Telephone: 2669 AVENUE. Telegrams: "LUMINOSITY."

NITRATE of Thorium and Cerium.

FABRIK CHEMISCHER PRAEPARATE VON STHAMER, NOACK, AND CO., HAMBURG.

DISPENSE WITH CANNEL COAL

and

INCREASE YOUR ILLUMINATING POWER

by using the

WHESSOE-MUNICH BENZOL CARBURETTER

The Cheapest and Best in the Market.

The Managers of Tynemouth, Middlesbrough, and Darlington Gas-Works are much pleased with it, and would not be without it.

Apply to the Sole Makers:

THE WHESSOE FOUNDRY COMPANY, LIMITED, DARLINGTON.

HEATHCOTE GAS COAL.

Rich in Illuminating Power and Yield of Gas.

Above the Average in Weight and Quality of Coke.

Maintains a High Standard in Residuals.

THE GRASSMOOR CO., LD.,

CHESTERFIELD.

WELDON MUD

FOR

GAS PURIFICATION,

For use in the

RECOVERY OF SULPHUR,

ALSO

Removal of last Traces of SULPHURETTED HYDROGEN in catch position.

Full Particulars on application to the Patentees

GAS DESULPHURIZATION CO.,

— *LIMITED*, —

1, FENCHURCH AVENUE, LONDON, E.C.

UNEQUALLED.

Gas Companies are solicited to try Samples of the

MIRFIELD

BLACK BED GAS COAL.

Prices and Analysis on application.

MIRFIELD (GAS-COAL) COLLIERY COMPY

RAVENSTHORPE, NEAR DEWSBURY.

Awarded HIGHEST MEDAL and DIPLOMA at the Newcastle-on-Tyne Royal Mining and Industrial Exhibition, 1887,

for

CANNEL & COAL.

TYNE

BOGHEAD CANNEL.

Yield of Gas per ton	13,155 cub. ft.
Illuminating Power	38·22 candles.
Coke per ton	1,301·88 lbs.

EAST PONTOP GAS COAL.

Yield of Gas per ton	10,500 cub. ft.
Illuminating Power	17·8 candles.
Coke	70 per cent.

SOUTH PELAW MAIN GAS COAL.

Yield of Gas per ton	10,500 cub. ft.
Illuminating Power	16·3 candles.
Coke	73·1 per cent.

For Prices and complete Analysis, apply to

THOS. W. DANCE, SON, & HUNTER,

COAL OWNERS, NEWCASTLE-ON-TYNE

OR

E. FOSTER & CO.,

21, JOHN STREET, ADELPHI, LONDON, W.C.

JAMES MILNE & SON, LTD.:,

GAS ENGINEERS

MILTON HOUSE WORKS EDINBURGH.

LONDON. —— LEEDS. —— GLASGOW.

JOHN BROWN & CO., LTD., SHEFFIELD,

Proprietors of

ALDWARKE MAIN, CAR HOUSE & ROTHERHAM MAIN COLLIERIES, NEAR ROTHERHAM.

ALDWARKE MAIN GAS COAL

Analysis: 12,600 Feet of 19-Candle Gas per Ton.

Value in Pounds of Sperm, 820·80.

VERY FREE FROM IMPURITIES.

TELEGRAMS: "ATLAS SHEFFIELD."

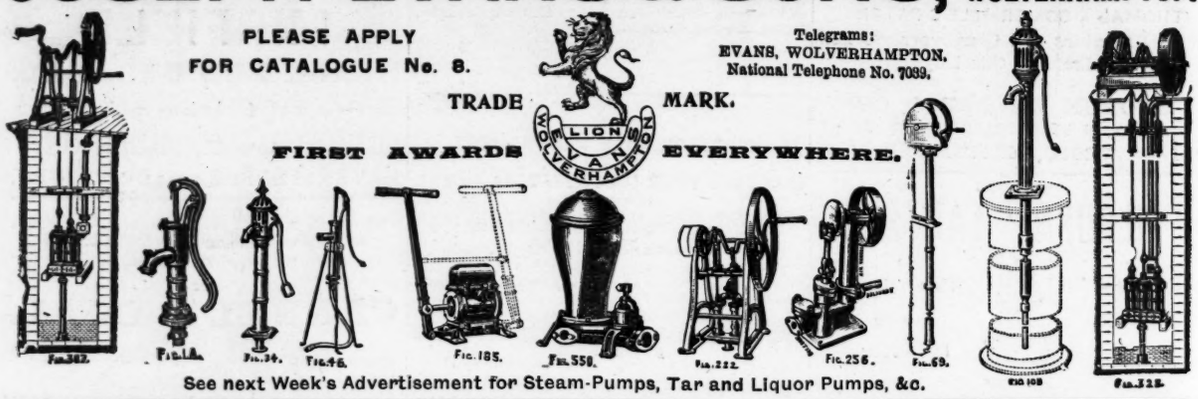
JOSEPH EVANS & SONS, CULWELL WORKS, WOLVERHAMPTON.

PLEASE APPLY FOR CATALOGUE No. 8.

Telegrams: EVANS, WOLVERHAMPTON. National Telephone No. 7039.

TRADE MARK.

FIRST AWARDS EVERYWHERE.



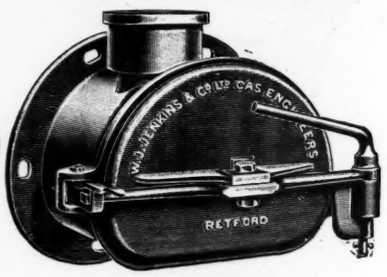
See next Week's Advertisement for Steam-Pumps, Tar and Liquor Pumps, &c.

MOUTHPIECES

WITH SELF-SEALING LIDS FOR HORIZONTAL AND INCLINED RETORTS.

SOLE MAKERS OF

THE "DE BROUWER" PATENT COKE-CONVEYOR.



W. J. JENKINS & CO., LTD., RETFORD.

R. LAIDLAW & SON, LIMITED,

ENGINEERS & IRONFOUNDERS,

CAST-IRON PIPES

ALL SIZES.

MANUFACTURERS OF

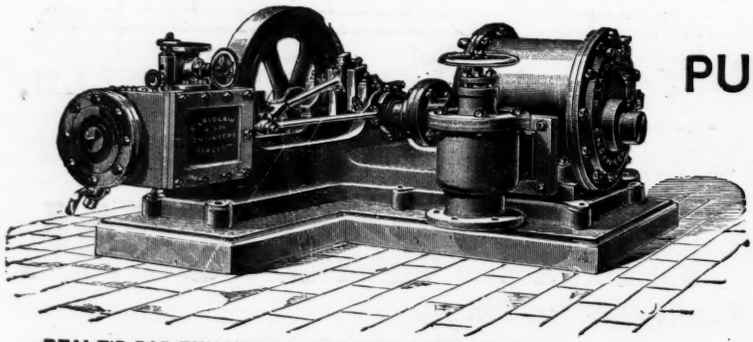
STEAM-ENGINES,

EXHAUSTERS,

VALVES,

AND

PUMPING-ENGINES.



BEALE'S GAS EXHAUSTER AND ENGINE COMBINED. ALL SIZES.

ALL KINDS OF

GAS AND WATER APPARATUS.

ALLIANCE FOUNDRY, GLASGOW. | SIMON SQUARE WORKS, EDINBURGH. | 6, LITTLE BUSH LANE, LONDON, E.C.

GANDY'S BELTING

THE

Gandy Belt Manfg. Co. (1901), Ld.

Works: SEACOMBE, CHESHIRE.

BRANCHES:—

LONDON, NEWCASTLE, MANCHESTER, BRISTOL, GLASGOW, BIRMINGHAM, BRADFORD, BELFAST.

Registered Trade Mark.

THE ORIGINAL.

Don't be Misled!

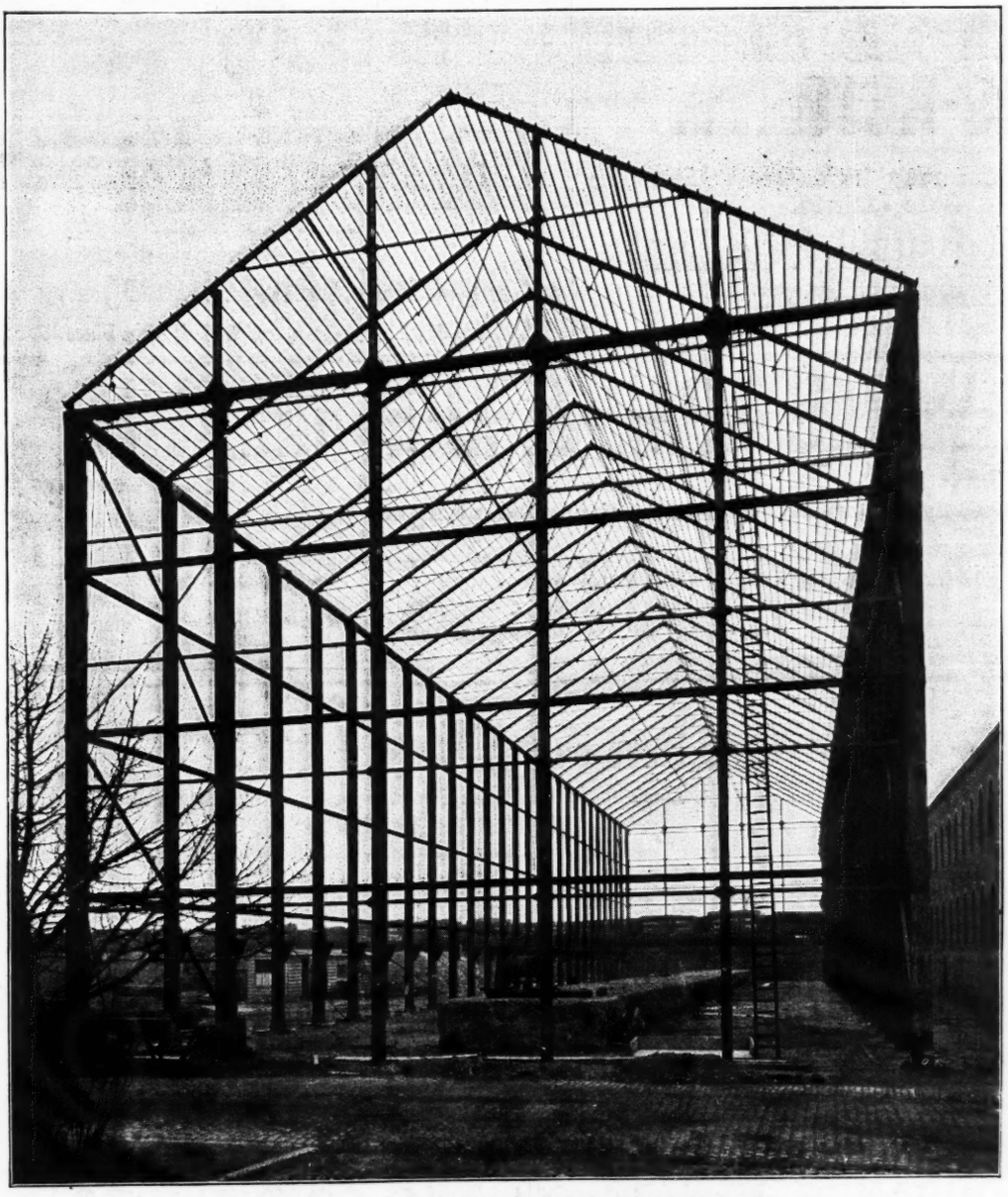
40 Awards!!

The World's Record!!!

LOOK FOR TRADE MARK.

WE MAKE A SPECIALITY OF ENDLESS BELTS FOR BLOWERS.

S. CUTLER & SONS, MILLWALL, LONDON.



EVERY KIND OF PLANT FOR GAS AND WATER WORKS. ROOFS. GIRDERS. TANKS. STEEL-FRAMED BUILDINGS.

STEEL RETORT-HOUSE RECENTLY ERECTED BY MESSRS. CUTLER.

GASHOLDERS. CARBURETTED WATER-GAS PLANT. **OIL-TANKS.**

THOMAS BUGDEN, MANUFACTURER OF

TAR and LIQUOR HOSE, and Special AIR TUBING.

BELLOWS made to inflate a 48-inch Bag under One Minute. Various sizes made.

Stokers' Mitts, from 13/6 doz.
Made from best Tanned Leather.

India-rubber Hose, Sheet, and Washers of every description, Leather Bands, Oils, &c., Diving and Wading Dresses, Waterproof Coats, Capes, Sewer Boots, and Theatrical Dresses.

Fire-Engine Hose and Appliances.

Best Materials and Workmanship Guaranteed.

Miners' Woollen Jackets No. 1, 12/- each; No. 2, 9/6.

Gas-Bags for Mains. Gas-Engine Bags.

71, GOSWELL ROAD, E.C.

ARROL-FOULIS
Patent Automatic Machinery
FOR
DRAWING AND CHARGING GAS-RETORTS.

Full Particulars may be obtained from the Sole Makers,

SIR WILLIAM ARROL & CO., Limited,
GLASGOW.

[See Illustrated Advertisement, Sept. 3, p. 549.]

Incandescent
GAS LIGHTS
Made in Birmingham.

All Materials best quality.

Trade Prices of **BURNERS,** 4s. 6d. Dozen, or with Galleries 7s. 6d. Dozen.

Trade Prices of **MANTLES,** 4s. Dozen. 42s. Gross. £14 per 1000.

Cash with Order.

Samples 1/3 postfree.

NOTICE.—The Birmingham Incandescent Lighting Company, Ltd., actually Manufacture **ALL** Mantles sold by them, and **DO NOT USE OXIDE OF CERIUM.** They therefore **CANNOT BE INFRINGEMENTS,** even supposing the Welsbach Patent to be valid.

THE
Birmingham Incandescent Lighting Co., Ld.,
280, Broad St., Birmingham, and 230, Market Place, Dudley.

THE WIGAN COAL & IRON CO., LIMTD.,

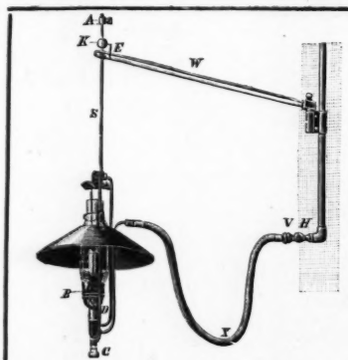
Are exclusive Owners of the well-known HAIGH HALL & KIRKLESS HALL GAS COAL COLLIERIES, and supply the Best Wigan Arley Mine Gas Coal, Gas Nuts, Gas Cannel, Cannel Nuts, &c.

Midland and West of England District Office: 6, CORPORATION STREET, BIRMINGHAM—Sole Agent: A. C. SCRIVENER.

Telegraphic Address: "WIGAN, BIRMINGHAM." Telephone No. 200.

London District Office: 6, STRAND, LONDON—C. PARKER & SON, Sole Agents.

Telegraphic Address: "PARKER, LONDON."



CENTRALWERKSTATT
(Branch of the **Deutsche Continental-Gas-Gesellschaft**), at **DESSAU** (Germany).

"INDUSTRINA" Swinging Bracket for
INCANDESCENT GAS-BURNERS.

British Patents, Nos. 14,494/00 and 2010/01, German Patent No. 120,032 and others.

Lamp suspended in a Perfect Anti-Vibratory Manner. Easily adjustable in EVERY direction. Best thing for Lighting with Incandescent Burners.

Mills, Workshops, Schools, Composing-Rooms, Artists' Studios, Writing-Rooms, &c

THOUSANDS IN USE ON THE CONTINENT!

Write for our Catalogue. BRITISH PATENTS FOR SALE. London Agent wanted.

WILLEY & CO., ENGINEERS, LONDON & EXETER.

Telegrams: "WILLEY, EXETER." Telephone: 132 and 263.

GAS APPARATUS OF EVERY DESCRIPTION.

ENGINES, EXHAUSTERS AND FITTINGS.

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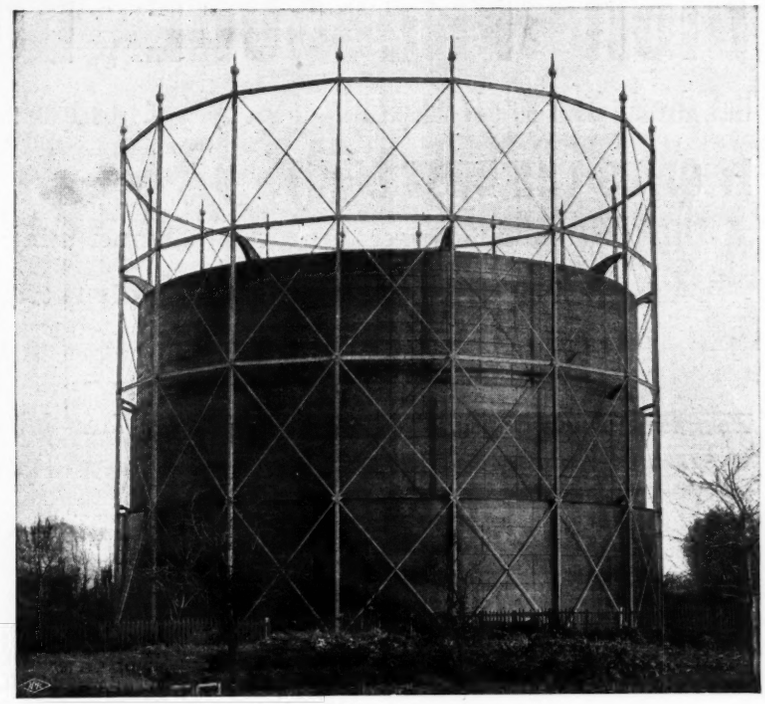
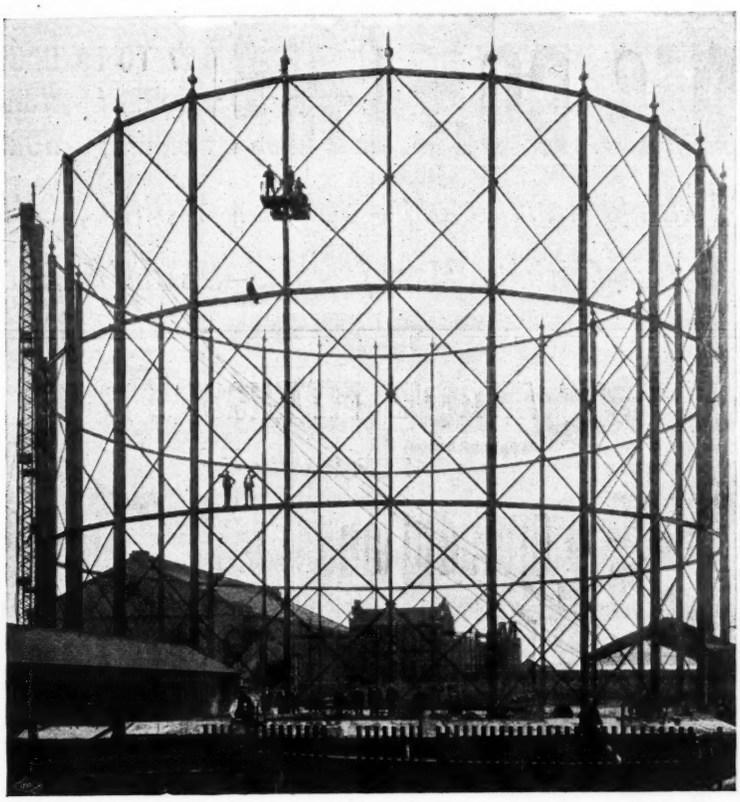


Three Lift Gasholder and Steel Tank, 90 feet diameter by 14 feet deep, recently erected for the EPSOM GAS COMPANY.



Three-Lift Gasholder, 145 feet diameter by 35 feet deep, in course of construction for the WANDSWORTH & PUTNEY GAS COMPANY.

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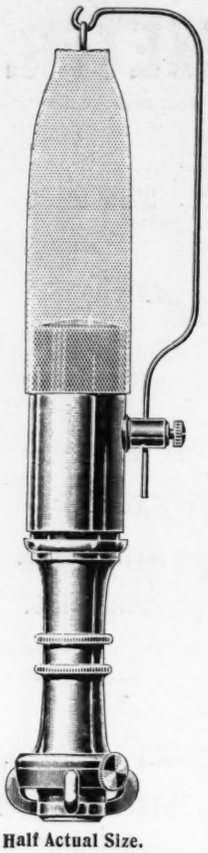

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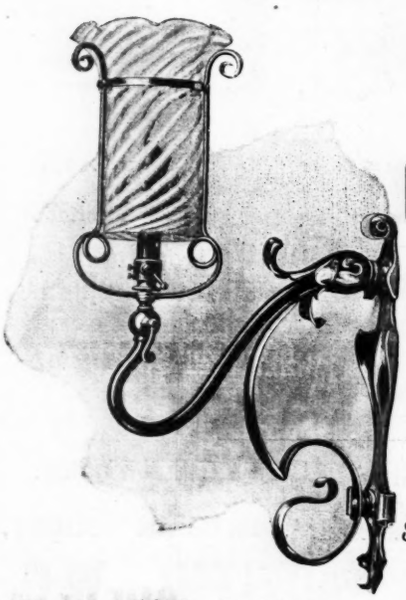

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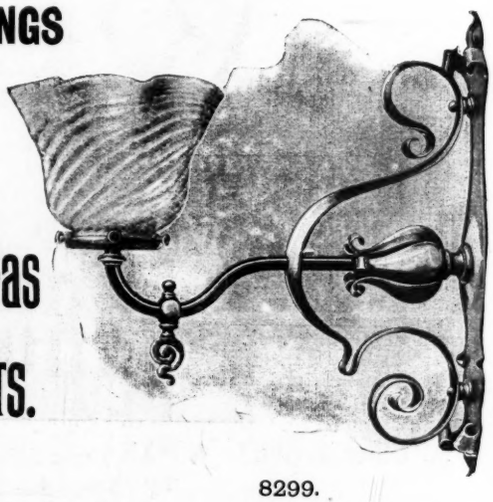

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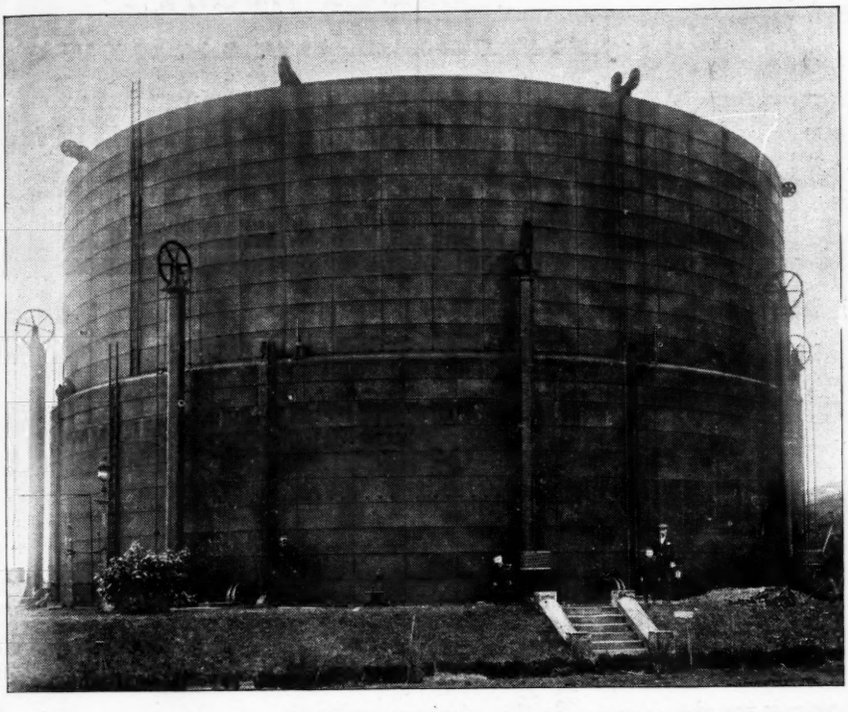

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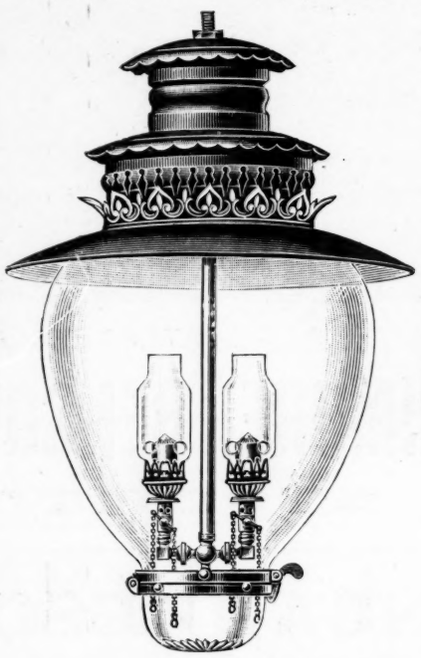

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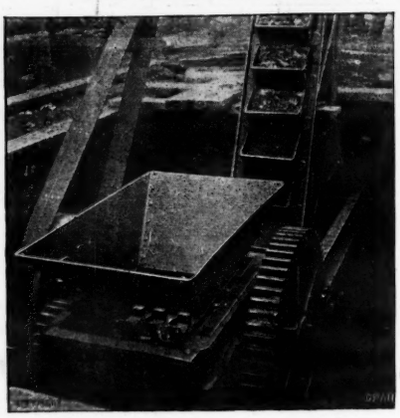

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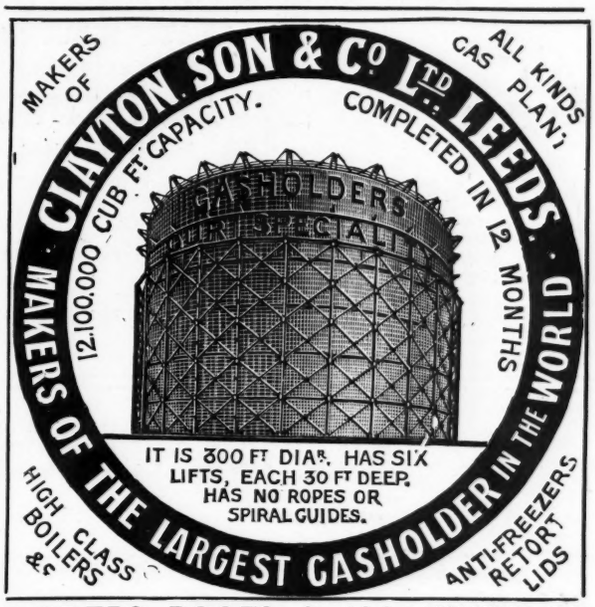
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